US Army Corps
of Engineers
Omaha District

32EM72: Results of Test Excavations on the East Shore of Lake Oahe, Emmons County, North Dakota

Prepared by:
Metcalf Archaeological Consultants, Inc.
Laramie, Wyoming

32EM72: RESULTS OF TEST EXCAVATIONS ON THE EAST SHORE OF LAKE OAHE, EMMONS COUNTY, NORTH DAKOTA

by
Anne McKibbin, Michael McFaul,
Karen Lynn Traugh, and Grant D. Smith

prepared for
US Army Corps of Engineers
215 North 17th Street
Omaha, Nebraska 68102-4978

prepared by
Metcalf Archaeological Consultants, Inc.
PO Box 899
Eagle, Colorado 81631
and
LaRamie Soils Service
PO Box 255
Laramie, Wyoming 82070

US Army Corps of Engineers
Contract no. DACW45-93-P-1218

North Dakota Antiquities Permit
expires 12/31/93

March 1994

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

32EM72: Results of Test Excavations on the East Shore of Lake Oahe, Emmons County, North Dakota

5. TYPE OF REPORT & PERIOD COVERED

Final

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

Anne McKibbin, Michael McFaul, Karen Lynn Traugh, and Grant D. Smith

8. CONTRACT OR GRANT NUMBER(s)

DACW45-93-P-1218

9. PERFORMING ORGANIZATION NAME AND ADDRESS

Metcalf Archaeological Consultants, Inc., Box 899, and Laramie Soils Service, Box 255, Laramie, WY 82070

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

DA, Corps of Engineers, Omaha District
215 North 17th Street
Omaha, NE 68102-4978

12. REPORT DATE

March 1994

13. NUMBER OF PAGES

51

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)

Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

archeology
cutbank
geoarchaeological analysis
Lake Oahe
Late Plains archaic
North Dakota
NRHP nomination
pedological analysis
radiocarbon date
site mapping
soil coring
test excavations

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Test excavations were conducted to better describe cultural materials eroding from a cutbank on the east shore of Lake Oahe, to provide chronological control for these materials, to determine their potential extent into intact deposits landward from the cutbank, and to provide recommendations for treatment of the site. The continually eroding site should be stabilized.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Abstract

Metcalf Archaeological Consultants, Inc. (MAC) conducted test excavations and other tasks at 32EM72, under contract to the US Army Corps of Engineers. The purpose of these investigations was to better describe cultural materials noted eroding from a cutbank on the east shore of Lake Oahe, to provide chronological control for these materials, determine through geoarchaeological means their potential extent into intact deposits landward from the cutbank, and to provide recommendations for further treatment of the site. Test excavations revealed as many as eight cultural levels in over 5 m of loess deposition. Dates are primarily Late Plains Archaic, and intensive faunal processing is indicated in two of the cultural levels. The site continues to erode, and cultural materials and contexts that contribute to the eligibility of the site have been and are being lost due to wave action. Immediate stabilization of the cutbank, or data recovery excavation is strongly recommended.

Table of Contents

List of Figures

List of Tables

INTRODUCTION

Metcalf Archaeological Consultants, Inc. (MAC) was contracted by the US Army Corps of Engineers (COE) Omaha District office to conduct test excavations at one area of archaeological site 32EM72 (Contract no. DACW 45-93-P-1218). 32EM72 is a large, multi-component prehistoric site on the east shore of Lake Oahe that is being eroded by wave action. The focus of this project was on a small area in the south end of the site where previous investigators had noted cultural materials eroding from a high cutbank formed by high water wave action.

Previous investigators have recommended that 32EM72 be considered eligible for inclusion on the National Register of Historic Places (NRHP) (Larson and Treat 1982; Larson et al. 1983). The North Dakota State Historic Preservation Officer has not been asked for concurrence on the evaluation, so no official determination of eligibility has been made.

The purpose of this project is to help the COE meet their obligations to Federal preservation legislation, including the Reservoir Salvage Act (1960) as amended, the National Environmental Policy Act (1969) as amended, the American Indian Religious Freedom Act, and Executive Order 11593. The National Historic Preservation Act, as amended, is specifically applicable.

The tasks that were completed toward this effort include a site-specific literature and records search, various field work tasks, analysis of recovered materials, and preparation of a report and a National Register of Historic Places (NRHP) nomination form for the site. The field work included test excavations, soil coring, site mapping, scaled drawing of the exposed cutbank, site boundary definition, surface collection of diagnostic artifacts, and establishing chronology for accumulation of sediments and cultural materials.

For MAC, Anne McKibbin served as Principal Investigator. Crew persons were Ed Stine and Andrea Kulevsky. Michael McFaul and Karen Traugh of LaRamie Soils Service conducted the soil coring. The Corps of Engineers was represented by Becky Otto. Fieldwork occurred on August 16 through August 23, 1993. Ralph Thompson, an avocational archaeologist from Bismarck, visited the site on several occasions during fieldwork.

MANAGEMENT SUMMARY

The test excavations completed at 32EM72 clearly indicate that this portion of the site can be considered a contributing element to the site's eligibility for inclusion on the

NRHP. This portion of the site has undergone extensive erosion from high water wave action on Lake Oahe, and, with the return of high water levels in the lake, continues to actively erode. The excavation of two test pits into the cutbank have served to weaken the cutbank and expose new materials to erosion and slumping. It is strongly recommended that action be taken to either stabilize the bank, or undertake more extensive data recovery excavation in order to salvage the cultural materials that remain in the cutbank.

PREVIOUS INVESTIGATIONS

32EM72 has been visited by professional archaeologists twice previously. It was initially recorded by Larson-Tibesar Associates (LTA) in 1982 (Larson et al. 1983) during a survey of several recreation areas proposed by the COE for the shores of Lake Oahe, North Dakota. At that time, the archaeologists noted cultural materials in four levels in the cutbank forming along the lake shore. These levels are referred to as "LTA Level #" for the remainder of this report in order to distinguish them from additional levels discovered during the current investigation. The lowest level, LTA Level 4, was noted at 3.3 m below surface. LTA Level 3 occurred about 30 cm above Level 4. LTA got a radiocarbon date of 3000±120 BP (Beta-6438) (Larson et al. 1983:115) from a sample of charcoal from the LTA Level 3 midden. LTA Level 2 and LTA Level 1 occurred higher up in the cutbank, and were each manifested by single hearths eroding from the cutbank and "associated cultural levels".

Their recommendations at the time of original recording were that the site was likely eligible for inclusion on the NRHP and that "prompt excavation" of that area was warranted, given the instability of the cutbank.

The site was revisited in 1986 by Virginia Gnabasik of the COE following reports by Ralph Thompson that artifacts ranging from Paleoindian projectile points to ceramics were actively eroding from the lake shore cutbank (Gnabasik 1986). At that time, the site boundaries were expanded considerably to include an area of exposed beach where bison bone and flakes were observed, and the cutbank sluff where additional bone was found. Gnabasik noted that no artifacts or features were noted in the cutbank itself north of the original locality recorded by LTA. She also notes that at times of high water, this northern part of the site is submerged.

The State Historical Society of North Dakota has on file an update to the site form dated September 5, 1990 (Thompson and McDonald 1990) that describes a visit to the site by Ralph Thompson and Doug McDonald (Park Manager, Bismarck Office, COE). It describes Mr. Thompson's discovery of a bone awl and fish hook eroding from the cutbank from LTA Level 3. This update also notes that it appeared that the cutbank had sluffed along a soil crack noted by LTA in 1982.

Ralph Thompson, a long-time resident of the area and currently from Bismarck, has been visiting the site for many years, initially to collect artifacts, but more recently as something of an informal caretaker. He has an extensive collection of materials that were

removed from the site, many of which are currently on loan to the Fort Abraham Lincoln Museum. Mr. Thompson brought parts of this collection to the site during fieldwork where they were examined and selected artifacts photographed.

Ann Johnson, National Park Service, Rocky Mountain Regional Office, Denver, has examined some of the ceramics collected from the site by Mr. Thompson along with other ceramic collections from the area. The results of her analysis were presented in a Plains Conference paper (Johnson 1992).

The 1986 investigations expanded the site to its current size and configuration (Gnabasik 1986). The site extends north-south along the lake shore for approximately 520 m. Artifacts extend out toward the lake from the cutbank for ca. 100 at the north end of the site only. This area was under water in August of 1993. Elsewhere, the site is defined in the cutbank only. The original recorded locality is at the extreme southern end of the expanded site. No artifacts were observed on intact surfaces above the cutbank in any locations, although Mr. Thompson reports collecting artifacts from several areas shoreward of the cutbank.

SUMMARY OF WORK

In the course of completing this project, various tasks were undertaken involving field work, laboratory analysis, records research, and discussions with an informant. Fieldwork included test excavations, soil coring, site mapping and profiling the cutbank.

The scope of work called for two square meters of excavation to be placed along the cutbank in a location that would encounter the hearths and cultural levels identified at the site during its initial recording (Larson et al. 1983). A 1x2 m excavation was started over the location of the best concentration of artifacts and datable materials apparent in the cutbank. This excavation covered the portion of the cutbank shown on the left edge of the profile photo in the LTA report (Larson et al. 1983:Figure 16). A second 1x1 m excavation was started several meters to the south of the first, over an area where a previously unrecorded hearth was found. This excavation started part way down the cutbank, and continued to a depth of about 5.40 m below present ground surface.

Depth of excavation was not anticipated to exceed about 3.5 m below surface, based on information in the original scope of work. This estimation was misleading because LTA measured depths below surface from the eroding gully slope instead of the adjacent intact ground surface. Excavations in fact went to a maximum depth of 5.40 m below present ground surface and encountered cultural materials to that depth. Excavation was not continued because of slump material at the base of the cutbank at this depth. Deeper excavation would have necessitated extensive removal of slump material and increased the height and significantly increased the instability of the existing cutbank. Cultural materials, if present below 5.4 m below surface, are still somewhat protected by the slump material from additional erosion. Deeper excavations along the cutbank, without extensive excavation

and removal of overburden shoreward of the cutbank, will increase the already significant safety hazards of working under this cutbank, and will accelerate the erosion of the cutbank.

Laboratory analysis included descriptive analysis of the chipped stone assemblage, taxonomic identification of the faunal materials and taxonomic identification of a small assemblage of seeds and macrobotanical remains recovered from fine screen samples.

Pedological and geomorphological analysis included detailed descriptions of one complete and several partial soil column, and completion of a soil coring effort in the cutbank's landform. The objectives of geoarchaeological investigations at 32EM72 were two-fold. First was to assess the origin of the site sediments and the potential of the sediments at the site to yield cultural materials. Second was to assess the potential horizontal extent of the known cultural strata at 32EM72.

Site mapping was completed using a total station. Since a large portion of the site is currently submerged, only the part of the site in the vicinity of the cutbank excavations was mapped. The total station was also used to produce a profile of approximately 35 meters of the cutbank and the major cultural and pedologic features. Both of these illustrations can be found in the back pocket of this report.

Records research included examination of all previous site forms produced for the site, and all reports directly applicable to the site (Larson et al. 1983; Gnabasik 1986; Thompson and McDonald 1990). In the process of completing the National Register nomination, various other regional sources were consulted, including the state comprehensive plan (SHSND 1990), the Northern Border Pipeline project (Root and Gregg 1983), and report of excavations at the Naze site (Gregg 1987a).

Ralph Thompson, of Bismarck, visited the site on several occasions during fieldwork. He provided helpful information about the site, and brought his extensive collection of materials from 32EM72 and other nearby sites. Examples of the 32EM72 material were photographed at that time, and some of these photographs are included in this report.

METHODS

Excavation

Work at 32EM72 began with the excavation of three 1 sq m test pits (TP), two of which were adjoining (TPs 1 and 2). TP 3 was excavated a short distance away, and focused on a hearth discovered in the cutbank during preparation of a soil column. The placement of TPs 1 and 2 was directly over the portion of the profile where LTA had identified two hearths in upper levels and recovered datable material from lower levels.

Excavation in TPs 1 and 2 proceeded in 10 cm levels, measured below ground surface initially, and then measured below certain clearly identifiable soil strata as depth increased. This method was chosen primarily because the test pits were located where the present

ground surface slopes considerably in the direction of a deep gully a few meters to the north. The stratigraphy, clearly visible in the cutbank prior to excavation, mimicked the slope of the ground surface at the top of the excavation, but as depth increased, the inclination of strata decreased to a point where it was nearly level at the bottom of excavation. By using various clearly identifiable strata to reorient excavation levels as depth increased, excavation levels generally retained the inclination of the natural and cultural stratigraphy. Near the bottom of excavation, two distinct cultural levels were visible; each was excavated as a separate level.

TP 1 was the first excavation opened on the site. Once started, the inclination of strata observed in the cutbank at the top of TP 1 was fairly quickly determined to be the result of slumping of the gully slope, rather than reflecting the orientation of the original depositional units. The slumping has disturbed the soil to some extent, primarily by imparting increased inclination, but by orienting the excavation levels with the observable strata and the ground surface, the excavation levels approximate the stratigraphic levels.

Excavation in TP 3 proceeded in the same fashion. However, because TP 3 was begun at over 3 m below present ground surface where the natural stratigraphy was nearly level, the initial excavation proceeded in horizontal levels, measured below an arbitrary datum. Toward the bottom of the excavation, the strata took on an increasingly steep dip to the north, and excavation levels dipped corresponding to the stratigraphy.

The scope of work for this site called for excavation of 2 sq m along the cutbank edge. This excavation was to extend to at least 3.3 m below surface where it would encounter the lowest cultural level then identified at the site (LTA Level 4). MAC anticipated that much of the matrix through which this excavation would proceed would contain little to no cultural materials. In the technical proposal (MAC 1993) accepted by the COE it was proposed that where this could be demonstrated through systematic excavation of one of the two square meters, corresponding levels in the other square meter would be removed without screening (as overburden). At least 1 sq m was systematically excavated through every depth between ground surface and 5.40 meters below surface and two square meters were excavated through the significant cultural levels.

All fill was screened through quarter-inch mesh hardware cloth. A 10%, or 10 liter sample was removed from each level and waterscreened through sixteenth-inch mesh. All residue that did not pass through the fine screen was dried and lab sorted to remove artifacts, bone, charcoal, and macrobotanical specimens. All artifacts recovered from the sixteenth-inch waterscreening, regardless of whether they would pass through quarter-inch screen, were catalogued and analyzed as part of the waterscreen sample.

Hearth features were excavated by first exposing the feature in plan, mapping and photographing it, and then removing the feature fill. All feature fill was screened through sixteenth-inch mesh. Profiles were drawn of the feature and photographs taken.

Surface Collection, Mapping and Site Boundary Definition

During fieldwork, the entire site area not submerged was carefully reexamined. This included inspection of the cutbank over the entire length of the site. Surface visibility was non-existent because of healthy grass cover, with the exception of occasional rodent backdirt piles and the road that skirts the eastern edge of the site.

Surface collection of diagnostic materials was part of the original scope of work. None were found on the intact ground surface. Several artifacts, including ceramics, were found on the slump below the cutbank in the area of excavations. These had eroded from subsurface contexts in the cutbank and were not collected for lack of association.

Ralph Thompson's collection was examined and provides ample evidence of the chronological range, and to a lesser extent the range of activities represented at the site. Unfortunately, provenience information for his collection is limited.

Refinement of the site boundary was not possible. Most of the site was under water at the time of fieldwork. Those land forms adjacent to the shoreline where artifacts might be expected on the surface were completely lacking surface visibility and no artifacts were found. Artifacts were observed in the cutbank and on the slump below the cutbank, but only in the area of excavations. Although the COE scope of work hints that soil coring might be used to help in this regard, its utility for discovery of cultural material lies entirely in its ability to identify deposits that might be likely to preserve cultural remains. The discovery or identification of artifacts or features in soil cores is statistically extremely unlikely.

Because of the lack of surface visibility, the inability to identify site boundaries based on in-field evidence, and the fact that much of the expanded site as recorded by Gnabasik (1986) is submerged, site mapping focused on the area at and in the vicinity of the cutbank excavations. Mapping data was downloaded and transferred by disk to Uintah Engineering and Land Surveying in Vernal, Utah, for production of the map.

Soil Coring

Soil coring was accomplished by LaRamie Soils Service, of Laramie, Wyoming. Field work began with a pedestrian reconnaissance to evaluate the extent, age, and origin of the terrains within the site boundaries (after Way 1978). As a result of the reconnaissance, a coring grid was designed to assess the potential of the subsurface sediments (McFaul et al. 1991). Locations and elevations of 17 coring stations were recorded together with the locations and elevations of relevant landforms (e.g. the cut banks and the gully) using a total station. The coring grid points were cored using a Giddings Soil Exploration device. Individual cores were 5 cm in diameter and were bored to a depth that encountered the Cretaceous Fox Hills (Clayton et al. 1980) bedrock or to a depth where the difficulty of penetration forced the machine's 1.5 m long anchors to pull free. The recovered cores were described using established geologic and pedologic criteria (Birkeland 1984; Krumbein and Sloss 1963). This data was combined to produce a three dimensional map of the subsurface strata. Individual coring logs are on file at LaRamie Soils Service.

Cutbank Profile Description and Mapping

Approximately 35 m of the cutbank in the area of excavation was examined using two techniques. One complete detailed soil column was examined and described in the area of TP 3. Additionally, cultural and macro-stratigraphic features were identified over the entire 35 m. A diagram of the larger, more general profile was produced using the total station to essentially "map" the face of the cutbank.

The cutbank was profiled to define the soil-stratigraphic-cultural relationships. Representative strata, cultural levels, and soil horizons were also described using standard pedologic and geologic procedures (Birkeland 1984; Krumbein and Sloss 1963). In turn, these descriptions together with archaeological evidence and radiocarbon dates were employed to assess the age/origin of the sediments exposed in the cutbank and in the recovered cores.

Artifact Analysis

Chipped stone debitage and tools, hammer stones, bone, and macrobotanical remains were recovered in excavations at 32EM72. Fire-cracked rock (FCR) was found, but was not collected or analyzed beyond noting its presence. Chipped stone debitage was subjected to a flake type analysis based on methods described by Ahler (1986) and Sullivan and Rosen (1985). Flakes were assigned to one of the following four categories:

Hard hammer flakes: Hard Hammer or "Other Good Flakes", as Ahler calls them (1986:70), include flakes that can be readily classified as deriving from hard hammer freehand percussion as well as all other flakes having uncertain technological origin and which are not classifiable according to any of the three other types. This category is in a sense a "residual" category.

Biface thinning flakes: Biface thinning flakes are, as the name implies, derived from reduction of bifaces by means of percussion.

Flake fragments: Flake fragments are a type borrowed largely from Sullivan and Rosen (1985) and are included within Ahler's "shatter/chunk" category (1986). These pieces retain sufficient morphological traits to determine that they were produced by percussion or pressure flaking, but are too incomplete to classify into one of the more specific categories.

Debris/shatter: Debris and shatter are irregularly shaped chunks of knappable material that do not retain evidence of flaking or flake orientation. Sullivan and Rosen's definition is pieces for which a single ventral surface cannot be identified (1985).

Many flakes recovered in the fine screen samples were too small to determine either flake type or material. These were simply counted. Material types included a preponderance of Knife River Flint (KRF), but various cherts, chalcedonies and quartzites were also present.

Chipped stone tools and hammer stones were simply measured and described. Special attention was paid to the technology of manufacture--whether a flake tool or biface--and to the nature of the working edge.

The faunal assemblage from 32EM72 was analyzed by Ronald J. Rood of MAC using comparative materials in his possession. Bone that could not be identified was assigned to categories based in part on the work of Lyman (1979) where size categories are used to obtain the most information from bone fragments that cannot be identified to specific taxa. The categories used in this analysis include:

Indeterminate Bone Fragments: In these cases, it cannot be determined if mammal or bird bone is represented. Generally, very few fragments are assigned to this category and typically only very small fragments are included.

Indeterminate Mammal Bone Fragments: Bone fragments assigned to this category consist of small fragments (0.5 cm to 2-3 cm in diameter) where it can be determined the bone is from medium to large mammals (dogs to bison) but no further information can be determined with any degree of accuracy. In most cases, bone assigned to this category is the result of intensive bone marrow extraction and grease production.

Indeterminate Large Mammal Bone Fragments: Bone assigned to this category consists of fragments of a size or with sufficient features to determine that the bone came from a large mammal. Large mammals include antelope, deer, elk, bison, horse, bear, etc. In some cases, the particular element can be determined but a taxonomic determination cannot be made.

Indeterminate Small Mammal: Small mammals are in the size range of mice, voles and small ground squirrels. In some cases, the particular element could be determined but the specific taxonomic identification could not be made.

Elk/Bison Size: Bone fragments assigned to this category are in the size range of elk or bison, but, due to the fragmentary nature of the bone, specific taxonomic determinations cannot be made.

Deer/Sheep/Pronghorn Size: This category is conceptually the same as the elk/bison category and includes fragmentary bone that can be assigned to animals in the size range of deer, sheep and antelope. In some cases, the particular element can be determined but again, specific taxonomic determinations could not be made.

Indeterminate Small Bird: One bone from this assemblage was assigned to this category. Small birds are in the size range of small perching birds such as finches or sparrows.

Selected macrobotanical remains were submitted to Margaret A. Van Ness (Golden, Colorado) and Carol Brandt, Paleoethnobotanist, Zuni Cultural Resource Enterprise (Zuni, New Mexico) for taxonomic identification.

RESULTS

Material Culture

The excavations at 32EM72 recovered 910 pieces of chipped stone debitage, two projectile points, 13 other chipped stone tools, two hammer stones, approximately 4728 pieces of bone, and several dozen seeds and plant parts. Fire-cracked rock was noted in many levels but was not further analyzed or collected. No ceramics were recovered in

excavation, although several pieces were noted in the slump material at the base of the cutbank. These were not collected for lack of original provenience.

Chipped Stone Debitage. The chipped stone debitage from excavations at 32EM72 includes 910 flakes. Seven hundred twelve (78.2%) were recovered from the fine screen samples and 601 of those were too small to identify by type. Table 1 and Table 2 provide cross tabulations of flake type by material type for the flakes recovered in general level screening and from fine screen samples.

Table 1 Flake summary (quarter-inch screen)

material	hard hammer	biface thinning	frag-ment	debris/ shatter	row total
KRF	100	12	60	11	183
yellow-brown chert	5	1	5		11
white quartzite	1				1
gray quartzite		1			1
red chert				1	1
tan chert					
porcelanite	1				1
chalcedony					
column total	107	14	65	12	**198**

Of the 309 flakes where material type was determined, KRF is the overwhelming favorite at 90.3%. A similar frequency of KRF can be assumed in the assemblage of micro-debitage. The presence of such a high frequency of micro-debitage from a sample that constitutes only 10% of the excavated matrix, is indicative of relatively intensive flintknapping activities. Although not quantified, it was the impression of the analyst that most of the micro-debitage were small bits of debris and shatter and only a small percentage was small finishing or maintenance flakes. That being the case, lithic reduction in the excavated areas of 32EM72 appears focused on initial reduction, with little in the way of tool manufacture and maintenance. The low frequency of biface thinning flakes suggests that little in the way of mid-range biface reduction was occurring.

Projectile Points. Two projectile points were recovered. One is a complete small side-notched point (32EM72.167), the other the base of a point (32EM72.168), probably corner-notched (Figure 1). The complete point resembles Timber Ridge Side-notched, an Avonlea type, but if so, is out of place both chronologically and spatially (Reeves 1983). The other basal fragment may be Pelican Lake. Both points were recovered from the same excavation level between LTA Levels 3 and 4.

Table 2 Flake summary (sixteenth-inch waterscreen)

material	hard hammer	biface thinning	frag-ment	debris/ shatter	micro-debitage*	row total
KRF	43	1	48	4		96
yellow-brown chert	2		3			5
white quartzite	3		3			6
gray quartzite			1			1
red chert						
tan chert		1				1
porcelanite						
chalcedony			2			2
undetermined*					601	601
column total	48	2	57	4	601	**712**

* these artifacts were too small to determine either flake type or material type

Chipped Stone Tools. Thirteen chipped stone tools were recovered at 32EM72 in addition to the two projectile points. Of these, two are other bifaces, ten are flake tools, and one is a core.

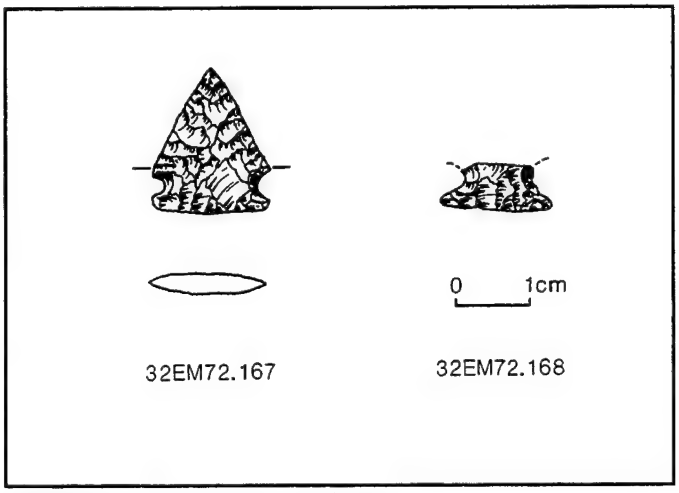


Figure 1 Projectile points

One biface, 32EM72.156, is made of tan chert and is a Stage 2 biface. The tip is missing and no use wear is apparent. Cortex remains on parts of one side. It measures 37 mm long (broken), by 27 mm wide and 7 mm thick. The other biface, 32EM72.157, is a Stage 3 artifact made of KRF. No use wear is present, both lateral margins are broken and it retains a small amount of cortex on one face. It measures 27 by 31 mm (both dimensions are broken), and is 11 mm thick. The single core is a piece of KRF with four negative flake scars on one side. It measures 67 x 41 x 14 mm.

The flake tool assemblage is summarized in Table 3. The flake tools are all relatively expedient. None could be considered formal or patterned tools. Edge angles vary widely, but most are in the 40° to 55° range, typical of tools that can be used for both cutting and scraping tasks. The frequency of polish and the near absence of step fracturing suggest that

Table 3 Flake tools

cat. no.	type of modification	material	L	W	T	edge angle	use wear	notes
32EM72.158	utilized	KRF	44	16	4	24	attrition	
32EM72.159	retouched	KRF	35	26	7	55	polish, attrition	
32EM72.160	retouched	gray qtzite		19	7	55	polish, attrition	broken
32EM72.161	utilized	Rainy Buttes		12	3	40	heavy attr, some polish	broken
32EM72.162	retouched	yel/brn chert		15	3	28	attrition	broken
32EM72.163	retouched	yel/brn chert		34	9	45	attrition, light polish	broken
32EM72.164	utilized	tan chert	37	15	8	65	attrition, polish	
32EM72.165	retouched	KRF	31	12	4	45	step fractures	
32EM72.166	retouched	KRF	25	21	6	48	attrition	
32EM72.169	utilized	yel/brn chert	33	24	3	75	attrition	burned

length (L), width (W) and thickness (T) in millimeters; edge angle in degrees

most of the materials on which these tools were used were somewhat soft, such as meat and hides, or soft plant parts.

Hammer Stones. Two hammer stones were recovered. These two artifacts are cobbles, otherwise unmodified except for areas where battering has fractured and pitted the surface. One measures 62 x 45 x 30 mm and weighs 132.5 gms. The other measures 109 x 83 x 60 mm and weighs over 600 gms.

Fauna. Approximately 4739 pieces of bone were recovered from the excavations at 32EM72. The number is approximate because in many proveniences, hundreds of small unidentifiable bone fragments were recovered and counts were only estimated. This is especially true of the constant volume samples processed through sixteenth-inch screen. The interprative utility of the fine screen sample of bone is primarily in demonstrating the degree to which the bone was processed, although post-depositional weathering and fragmentation must not be ruled at as a significant contributor to the bone's fragmentary nature. Table 4 provides a summary of the taxa and size categories represented.

Analysis of this site's faunal assemblage resulted in the identification of pronghorn, bison, deer, pocket gopher, mouse, non-poisonous snake, sharp-tailed grouse, vole, beaver and fox. There are, in addition, at least three species of fish represented in the assemblage including catfish (*Ictalurus* sp.). Minor weathering was noted on few of the pieces, but the assemblage overall is well preserved and shows little evidence of weathering. Even the fish elements were well preserved and in good condition.

Bison is represented by 16 bones while pronghorn is represented by 118 bone fragments. Pronghorn dominates the assemblage of identifiable bone. Beaver (*Castor canadensis*) is represented by 23 bones, most of which came from a single provenience (32EM72.17) in LTA Level 4; two mature animals are represented. Nine bones were

Table 4 Summary of faunal materials

taxon/category	common name	total count	appen-dicular*	axial*	cranial*
TAXA:					
Thomomys sp.	pocket gopher	3			
Ictalurus sp.	catfish	9			
Odocoileus sp.	deer	1			
Peromyscus sp.	mice	2			
Pedioecetes phasianellus	sharp-tailed grouse	2			
Bison bison	bison	16	11		3
Antilocapra americana	pronghorn	118	62	31	23
Microtus sp.	vole	2			
Castor canadensis	beaver	23			
Vulpes sp. (cf. *Vulpes velox*)	fox	1			
CATEGORY:					
indeterminate bone		770			
indeterminate mammal		3047			
indeterminate large mammal		364			
indeterminate fish		122			
indeterminate small bird		1			
elk/bison		44			
deer/sheep/pronghorn		212			
Artiodactyla	even-toed hooved mammals	1			
Colubridae	snake	1			
		4739			

* separated only for *Bison bison* and *Antilocapra americana*

tentatively assigned to the genus *Ictalurus*. Most of the unidentified fish bone from the assemblage can probably be identified with additional analysis and more comparative materials. There are at least three genera of fish, including the catfish, present in the assemblage.

Small mammals and birds are not well represented. Pocket gopher, mouse, and vole are represented by a few bones and one small bird premaxilla was noted. Two sharp-tailed grouse elements, a distal tibiotarsus and a complete tarsometatarsus, were recovered.

One canid bone, a left mandible fragment of a fox (possibly a swift fox, *Vulpes velox*) was recovered from LTA Level 4. This mandible fragment consists only of the anterior

portion, and it compares favorably to a red fox (*Vulpes fulva*) mandible in the comparative collection, but is considerably smaller prompting the tentative identification of a swift fox.

Evidence for cultural modification of the bone is abundant. Between 15% and 20% of the bone is burned and the collection is highly fragmented from cultural processing for marrow and grease. Most of the assemblage was categorized as indeterminate mammal bone fragments consisting of small pieces 1 to 5 cm in diameter. Larger pieces of bone, especially antelope and bison long bone fragments, displayed impact marks indicating deliberate breaking for marrow extraction.

Butchering marks were noted on a number of elements and bone fragments from the assemblage. A beaver (*Castor canadensis*) complete right humerus from LTA Level 4 displays a series of cut marks on the proximal end where it was disarticulated from the scapula and there are several cut marks along the diaphysis indicating muscle tissue was stripped from the bone. Another beaver element, a right astragalus, displays cut marks along the lateral face. A number of the beaver elements were burned.

One pronghorn (*Antilocapra americana*) right distal humerus displays cut marks on the lateral face of the distal articular end. Several deer/sheep/pronghorn size rib fragments display cut marks along the exterior and interior face of the rib. One rib fragment shows cut marks at the proximal articular end where the rib articulates with the vertebra. Cut marks were noted on several of the deer/sheep/pronghorn size long bone fragments as well as on several of the elk/bison size long bone fragments.

The collection displays a number of attributes suggesting bone marrow extraction and bone grease production were important activities associated with some of the site occupations. Most of the bone from the site is highly fragmented and there are virtually no complete large mammal long bones in the assemblage. Some broken bison and pronghorn phalanges were noted in the assemblage and a bison mandible recovered from LTA Level 4 displays an impact scar placed near the middle of the horizontal ramus which opened the mandibular marrow cavity. Several additional pronghorn mandible fragments were noted suggesting the mandibles had been fractured for marrow and grease production.

A relatively large collection of fetal bone was recovered from LTA Level 4 and was restricted to that level. At least three individual animals are represented that are most likely pronghorn. The size of the fetal bone compares well to the size of fetal deer elements collected from a fresh kill during early February in Colorado. This indicates a winter occupation for the LTA Level 4 component.

Canid gnawing was noted on several bones from the assemblage. Two of the pronghorn bones displayed canid gnawing and several of the elk/bison and deer/sheep/pronghorn elements also displayed evidence of canid gnawing.

Macrobotanical Remains. Several dozen seeds and plant parts were recovered, mostly from the fine screen samples. A systematic analysis of these remains was not undertaken, but two representative samples were sent for specific identification. Table 5 lists

Table 5 Sample of macrobotanical remains

taxa	common name	parts
CATALOG NO. 32EM72.111		
Celtis reticulata	hackberry	3 uncharred seed fragments
		4 charred seed fragments
Prunus virginiana	chokecherry	11 charred seed fragments
		2 charred fruit fragments?
unknown	seeds?*	35 charred whole seeds?
		11 charred seed? fragments
CATALOG NO. 32EM72.112		
Celtis reticulata	hackberry	7 uncharred seed fragments
Prunus virginiana	chokecherry	3 charred seed fragments
Vitis sp.	wild grape	3 charred whole seeds
unknown	unknown	1 charred fragment
unknown	unknown	1 charred fragment, possibly *Celtis*
unknown	seeds?*	7 charred whole seeds?

* may be seeds (probably grass) or insect excreta

the identifications of the two samples. Nearly all of the remaining macrobotanical material consists of *Celtis* (hackberry) seeds.

Features

Two basin hearth features were encountered in the excavation, along with one midden deposit. Feature 1 is a small, unlined basin marked by dark gray to black silt (Figure 2, Figure 3) and was truncated by the east wall of Test Pit 2. The basin measures about 35 cm in diameter, and about 6 to 8 cm deep. Several pieces of FCR were found at the top of the stained fill. No artifacts were recovered from the fill, nor was any charcoal visible. Oxidation is visible on the north edge of the feature. A bulk soil sample returned a radiocarbon date of 1990±60 BP (Beta-67850).

Feature 2 was somewhat larger and more elaborate and was truncated in the east wall of Test Pit 3. This hearth measured about 80 cm in diameter and about 15 cm deep (Figure 3, Figure 4, Figure 5). The fill of the basin was black and contained considerable quantities of charcoal. Approximately half a dozen large burned slabs lay on and immediately above the feature fill. A thin band of oxidation was noted outside of, but adjacent to, the north rim, near the center of the floor of the basin, and on the south side continuing onto the adjacent surface. Charcoal flecking also extended from the edge of the basin out onto the adjoining surface. The basin of Feature 2 was excavated into and slightly through a thin bone bed that occurs about 5 cm below the feature's surface. One of the bones protruded into the basin and was burned on that end.

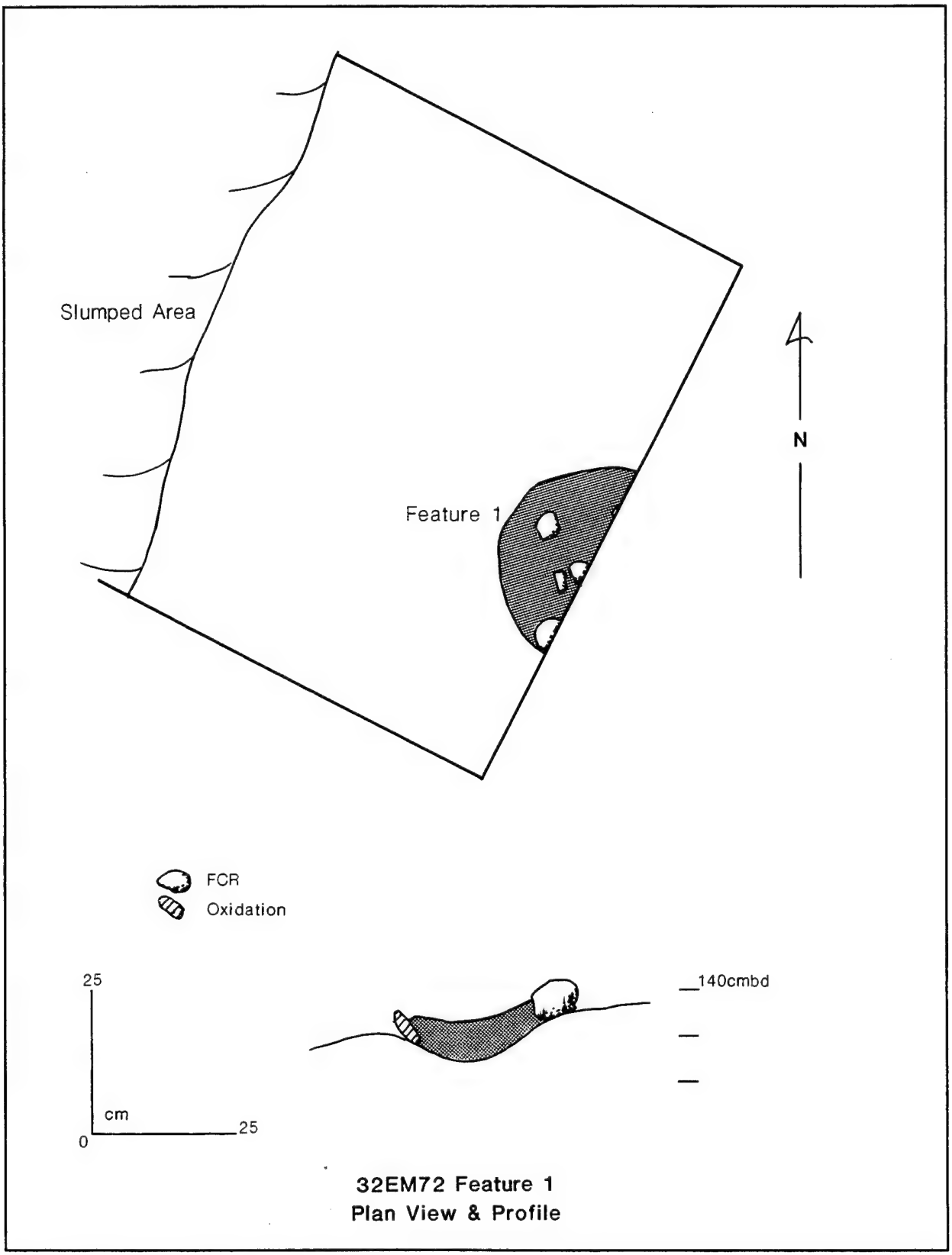
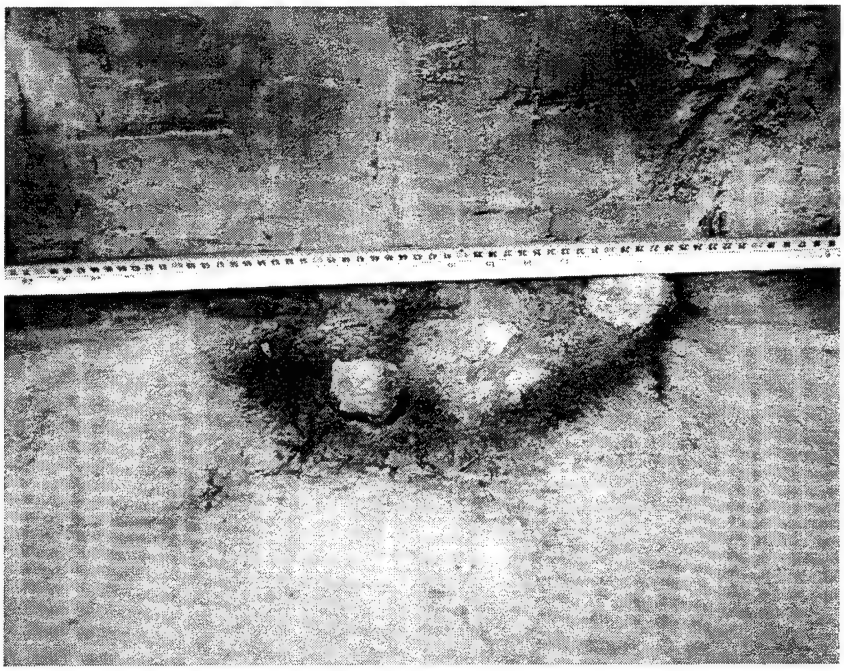


Figure 2 Feature 1 plan and profile



View of Feature 1 exposed in plan along the southeast wall of TP 2 at about 145 cm below datum or 35 cm below paleosol.

View of Feature 2 exposed in plan along the southeast wall of TP 3 at 85 cm below datum.

Figure 3 Features 1 and 2, photos

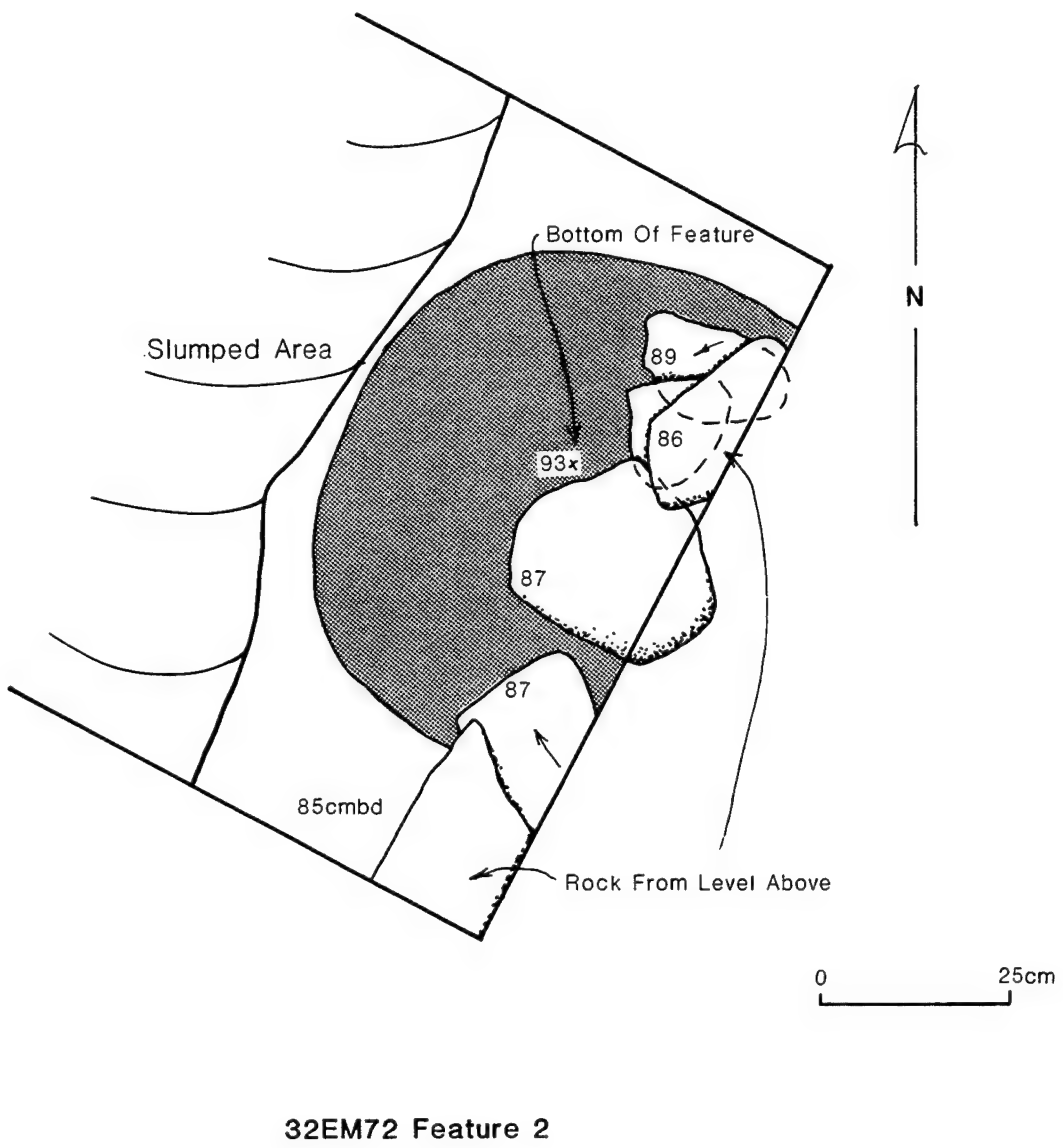


Figure 4 Feature 2 plan

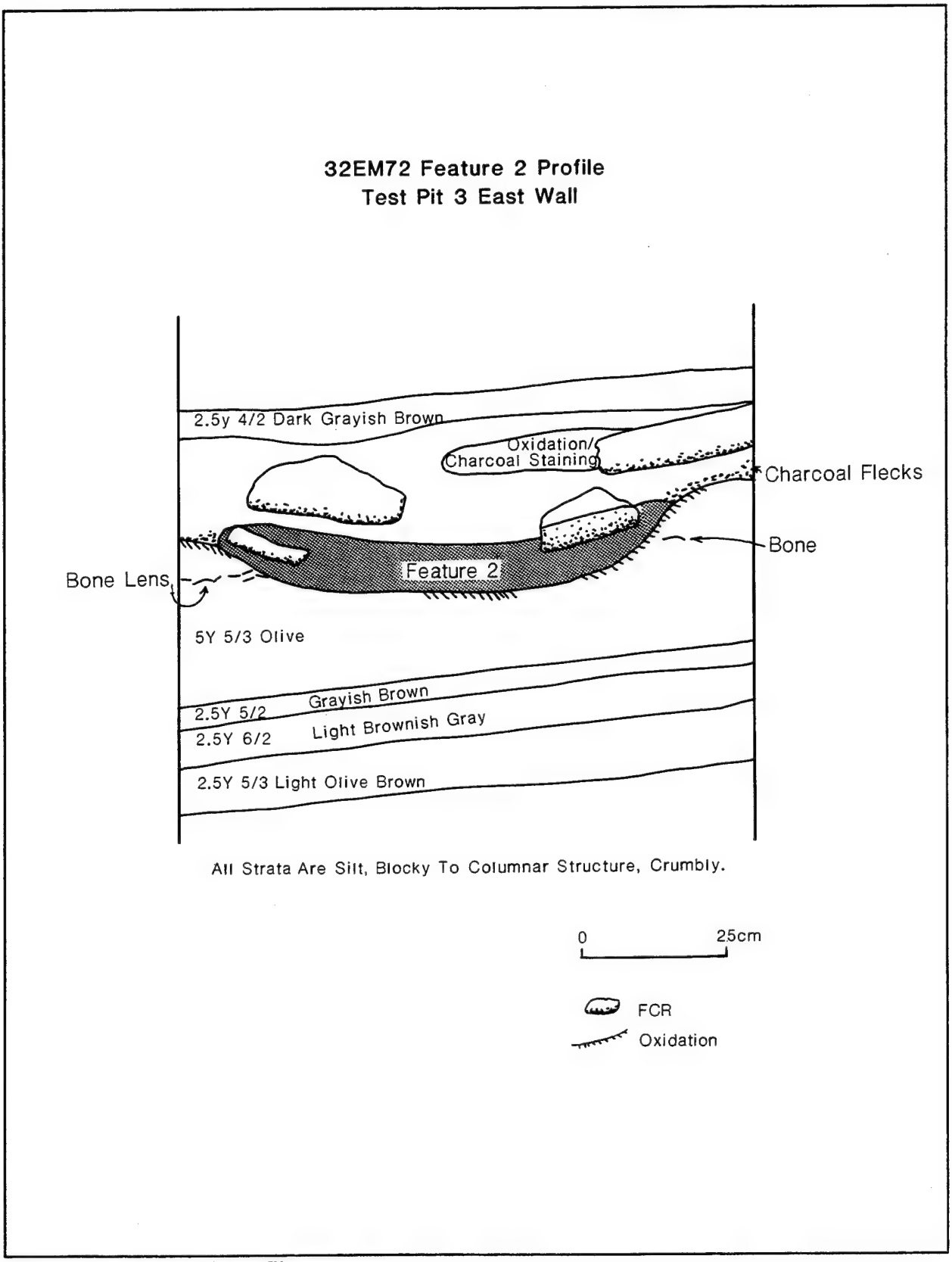


Figure 5 Feature 2 profile

The fill of Feature 2 contained 13 bone fragments and one piece of micro-debitage. The bone fragments include eight pieces of burned indeterminate mammal bone, four pieces of unburned indeterminate mammal bone, and the only piece of bone keyable to *Odocoileus*. A charcoal sample from the feature returned a date of 2700±60 BP (Beta-67847).

The midden is LTA Level 3 (Larson et al. 1983). It was clearly visible in the cutbank and was sectioned by Test Pit 1. In TP 1 it consisted of an ash-rich horizon varying between 10 and 12 cm thick. Ash, charcoal, burned rock, abundant bone and burned bone, abundant debitage, and burned soil were all noted. The lower contact of this level was somewhat irregular. It is possible a shallow feature was located in the southwest corner of the excavation. LTA's radiocarbon date of 3000±120 BP (Beta-6438) comes from this level (Larson et al. 1983).

Geoarchaeology

Physiography. Site 32EM72 is associated with loess sediments approximately 80 km south of Bismarck, North Dakota. Located on the left or eastern bank of the impounded Missouri River, a steep cutbank exposes portions of 32EM72 which date to >3000 BP. The cutbank is the result of wave action and lake level fluctuations of Lake Oahe. Having a surface elevation of approximately 506 meters a.m.s.l., the cutbank or western margin of the site forms the face of a terrace-like landform that is bounded to the south by an outcrop of the Cretaceous Fox Hills sandstone (Clayton et al. 1980) and to the north by a gully. The slightly northward dipping surface of the terrace-like landform extends eastward approximately 87+ m to the base of a scarp developed on the flank of what is mapped as a proglacial river terrace (Clayton et al. 1980) (site map, back pocket).

Review of the glacial chronology for North Dakota suggests that the study area experienced proglacial river activity at approximately 12,000 BP (Clayton 1966). Its elevation approximately 18 m above the now innundated Missouri River floodplain implies that the terrace-like landform at 32EM72 is similar in elevation above the river as the MT2 (Missouri River #2) terrace in South Dakota (Coogan 1960, McFaul 1985) which may date to the early Wisconsin (McFaul 1985:125).

Natural Stratigraphy. Profiles and descriptions of the soil/sediment relationships exposed in the cutbank indicate that on August 19, 1993, the surface of the landform was approximately ten meters above Lake Oahe at its southern margin and approximately eight meters on its northern margin (cutbank profile, back pocket). This downward grade of 14% continues to an gully flank on the north and to the base of a terrace riser on the east. However, the grade steepens eastward and the width of the surface decreases. Southward the cutbank is flanked by a northward dipping (8 to 11%) outcrop of variegated reddish brown to tan, very friable, moderately well sorted, coarse grained sandstone. In turn, this sandstone is mantled by a greenish-gray, very weakly cemented sandstone.

The position of this bedrock outcrop is significant (cutbank profile, back pocket). The surface topography suggests that this bedrock ridge extends east-southeastward from the

cutbank for at least several tens of meters. The outcrop forms a natural barrier to wind, behind which loess has accumulated. Such aggradation is evidenced by the dip of the stratigraphic bedding and pedogenic horizons observed in the cutbank exposure (cutbank profile, back pocket). Beds and horizons within the loess dip away from the outcrop in a pattern that suggests these deposits thin to the north or away from the outcrop.

Cultural components are preserved at different elevations within the loess. The radiocarbon dating of selected cultural features indicates that much of the loess accumulated in the late Holocene and thus precludes the deposition of at least the upper 5.5 meters of loess by late Pleistocene proglacial rivers. In turn, this limits the geoarchaeologic potential to Middle Archaic and younger cultural materials. However, it is important to note that this is a deep accumulation of sediment and that it was not possible to evaluate the age or cultural potential of sediments greater than 5.5 m below the surface.

The cutbank evidences numerous weak and buried paleosols developed in five of six loess deposits (Figure 6). Individually, the loess deposits are defined primarily by changes in soil development. The basal loess Unit I is a good example. Unit I is an accretionary deposit that exhibits at least four organic enriched, weak soil A horizons and a comparatively well developed stripped soil with a calcareous soil Bk horizon. The weak soil A horizons are considered to represent brief soil forming intervals that were possibly concurrent with loess deposition, whereas the presence of the stripped soil Bk at the upper boundary suggests an erosional environment. In turn, the organic rich horizons represent comparatively moist climatic regimes while the calcareous horizon suggests a comparatively dry climatic regime.

Cultural materials from loess Unit II, immediately above the stripped soil Bk horizon radiocarbon dated at 2700±60 BP. The position of these dated cultural materials and the position of other dated materials in a soil Ab horizon approximately 49 cm below the Unit I upper boundary suggest that loess deposition continued after 3080±60 BP and had ended prior to 2700±60 BP. These bracketing dates suggest that: a) the calcareous paleosol formed and was stripped in <380 years and b) loess was deposited rate of 0.13 cm/yr.

The absence of buried soil A horizons in loess Unit II and the presence of three charcoal lenses within this unit implies that either deposition of this unit was uninterrupted by climatic changes capable of soil formation or that deposition was so rapid/continuous that soil formation was precluded. Unit II exhibits subangular blocky soil structure and carbonate accumulations similar to Unit I. This suggests that, following deposition, Unit II experienced soil formation under a dry climatic regime. The absence of a soil A horizon with this calcareous paleosol indicates that Unit II was partially stripped prior to the deposition of the subsequent unit. Dating of the cultural feature at the base of this unit (2700±60 BP) provides a lower time boundary for the deposition of this unit. Application of the Unit I deposition rate to Unit II implies loess accumulation ended prior to ca. 2440 BP.

The stripped paleosol within loess Unit II is mantled by 18 cm of loess (Unit III) that lacks soil development. The presence of loess Unit III suggests renewed eolian deposition following the stripping of the paleosol on Unit II and prior to the deposition of the gravel

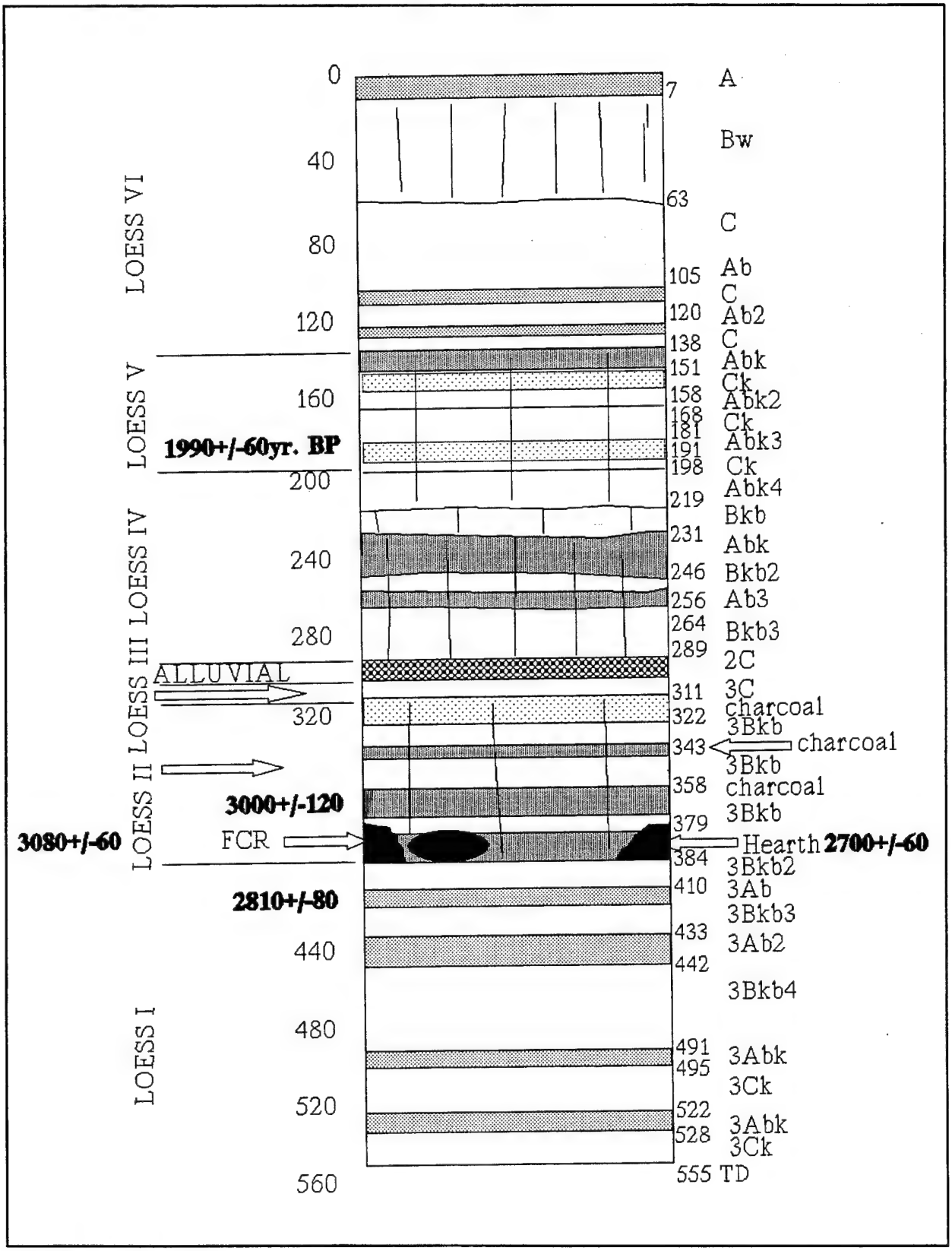


Figure 6 Soil profile

lens above it. The gravels' lens-like form, sandstone lithology, pebble size of the clasts, and clast angularity suggests sheetwash reworking of the Fox Hills Formation sandstone.

The soil/sediment relationships in loess Unit IV suggest three periods of eolian deposition and soil formation during this interval. Weak soil development in the second of three soils formed during this event suggests that the rates/intensity of soil formation varied. Dating of cultural materials in loess Unit V suggests that Unit IV deposition had ended prior to 1990±60 BP. By comparison, the Units II, III, an alluvial lens, and Unit IV deposition rates are higher at a rate of ca. 0.26 cm/yr.

The break between Units IV and V is sharp with a change in color hues (5Y to 2.5Y) and bones mantling the erosion surface. Unit V loess deposition resembles Unit I in that soil development is weak in all but the uppermost horizon and deposition appears to have been rapid. However, weak soil A horizons are present which implies that soil formation and deposition were concurrent. In fact, from a distance the entire unit has the appearance of one buried soil A horizon. Thus, this darkened "horizon" provides a soil-stratigraphic marker that is traceable across this cutbank exposure and probably in the cores recovered at 32EM72. In addition, this entire unit exhibits moderate, very coarse subangular block soil structure. Such an occurrence suggests the superposition of a second soil into Unit V. The fact that this second soil is represented by a subsurface diagnostic horizon (i.e. Bw) rather than a surface diagnostic horizon (i.e. A horizon) indicates that following the superposition of the second soil the area experienced an erosional event. The position of radiocarbon-dated cultural materials suggests that this erosional event occurred after 1990±60 BP. Relative age dating of the rates of deposition (0.097 cm/yr) suggests that by approximately 1372 BP the deposition, soil formation events, and the erosion of Unit V had ended. Loess Unit VI is a comparatively thick (138 cm) unit that exhibits two thin and faint (10YR6/2) paleosols beneath the modern soil. The upper half of the unit is dominated by the modern Inceptisol.

Coring. Approximately eight meters east of the cutbank, cores were bored in four transects (site map, back pocket) to illustrate the depth and extent of the loess collected in the lee of the rock outcrop at site 32EM72. Based on soil/sediment relationships exhibited in these cores, it appears that individual soil/sediment units tend to mimic the bedrock topography (Figure 7). However, the lack of chronostratigraphic controls makes it unclear how the paleosol identified in these cores correlates to the paleosol(s) exhibited in the cutbank profile. Compaction and moisture content also made it difficult to delineate definitive boundaries of the paleosol. However, it was possible to determine the proximity of the bedrock and the paleosol to the surface.

The paleosol thinned toward the southern and eastern boundaries of the coring grid. This thinning probably defines the margins of areas suitable for loess deposition in the lee of the bedrock outcrop. Because of this thinning, it is suggested that the paleosol does not extend far beyond the coring area. In addition, four cores within the coring grid did not contain the organically darkened (soil A horizon) paleosol (Figure 7). A distinct trend that would suggest why these cores did not contain the paleosol was not identified. However, if the paleotopography was similar to that seen today (i.e. undulating topography with

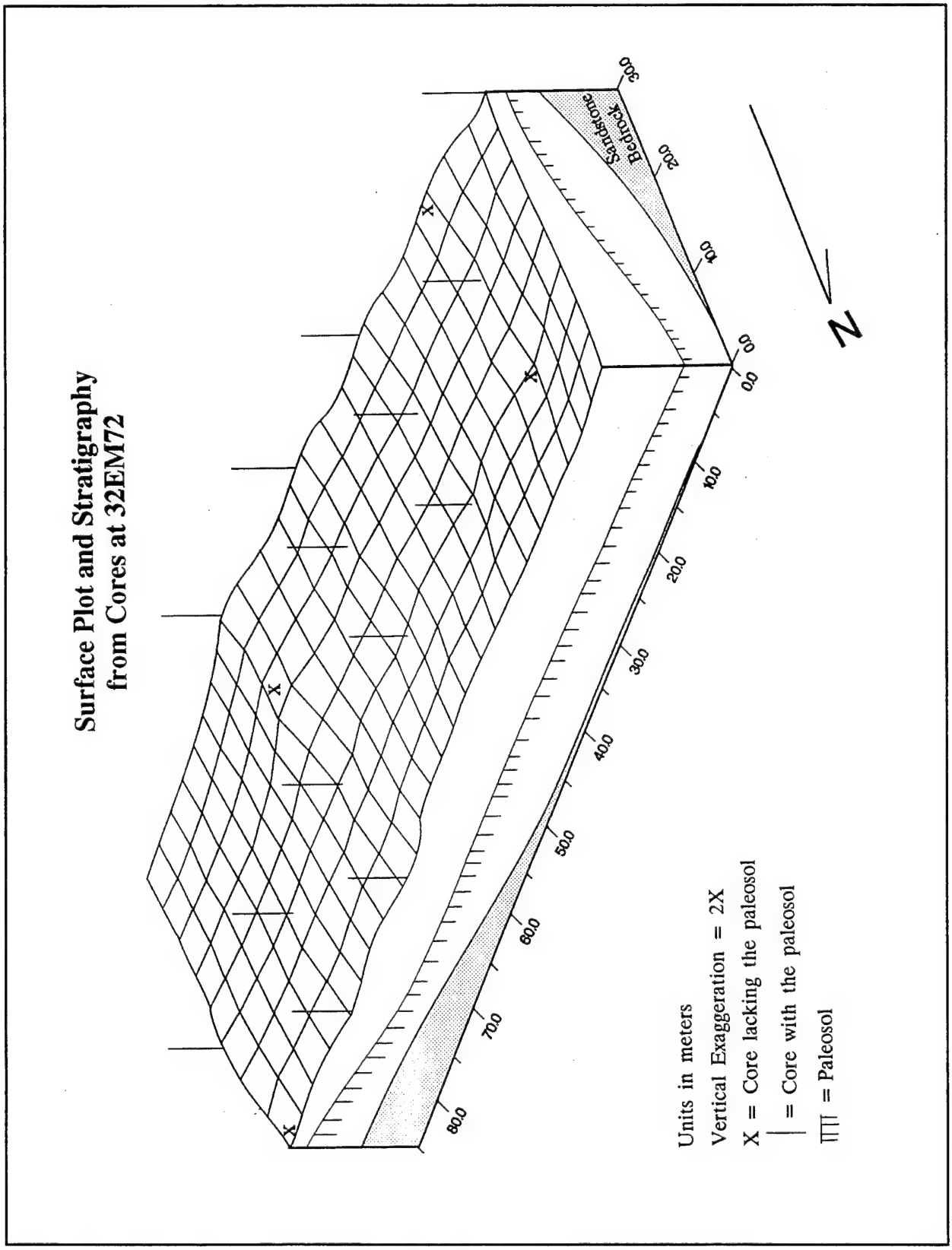


Figure 7 Surface topography and soil/sediment relationships in cores

ephemeral drainage channels) it is possible that the paleosol did not develop in these areas. It is equally likely that the lack of the paleosol in these four cores is the result of erosion, rodent burrows, or other disturbances.

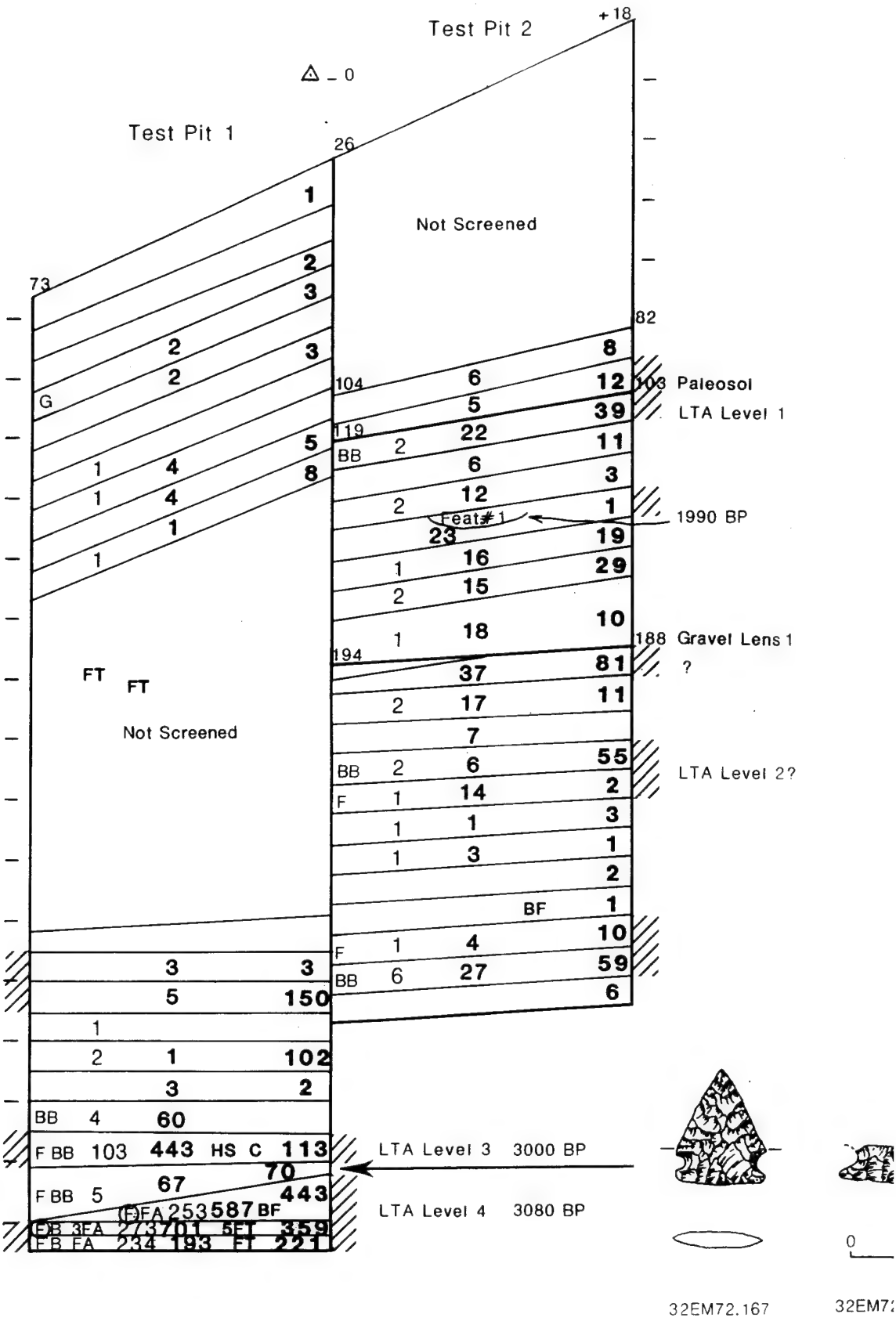
Due to the apparent continuity and integrity of the loess deposit, it is suggested that the entire 2550 sq m coring grid has the potential to contain cultural materials. If further archaeological work is undertaken, a closer interval coring program and a dating program are recommended. Additional coring would help refine the boundaries of the paleosol as well as improve the archaeologic sampling resolution within this deep (>5.5 m) loess. Soil dating would permit correlation of the paleosol(s) observed in the core with those present in the cut bank and subsequently refine the geoarchaeological potential of the sediments in the coring grid. Due to the relatively low energy of the environment associated with loess deposition, cultural materials preserved in this loess are probably *in situ*. The widespread occurrence of the paleosol, its depth below the surface, and the preservation potential of a loess matrix suggest that if other cultural materials are associated with this paleosol(s) they are presently unaffected by disturbance.

A significant limit to the utility of coring on this project is worth mentioning. While the recovered cores do allow important and informative conclusions to be drawn about the subsurface topography and the extent of Holocene loess, the level of detail recoverable from core samples simply does not come close to that available from the cutbank exposure. These inherent difficulties in trying to do detailed stratigraphic analysis and identification from core samples prevent an attempt at correlating all but the most major stratigraphic features through the area covered by the coring grid.

Cultural Stratigraphy

At least eight different cultural levels are present in this portion of the cutbank at 32EM72. Dates range from the early Late Plains Archaic through Middle Plains Woodland and probably on into Late Plains Woodland. No attempt has been made to name or label these levels, for reasons that are obvious when LTA's level number sequence is integrated into the sequence revealed in the current project. This limited amount of work probably has not identified all the discrete cultural levels present in this deep section. Namimg of the levels should be left to a more comprehensive and extensive excavation effort where it can be assumed with greater assurance that all the identifiable levels have in fact been found.

The test excavations at 32EM72 reached a maximum depth of 5.40 m below surface. They certainly did not reach the base of Holocene deposition, and may not have reached the bottom of cultural manifestations (excavations were discontinued for reasons discussed on page 3). Cultural material was found in nearly all levels (Figure 8), but by far the greatest concentration of artifacts occurred in two cultural levels in the bottom of Test Pit 1. These are LTA Levels 3 and 4 (Larson et al. 1983) and are the third and second lowest of the eight cultural levels identified in test excavations. The following discussion proceeds down the cutbank (refer also to Figure 8):


Test Pit 2
+18
0
Test Pit 1
26
Not Screened
73
82
G
104
103
Paleosol
LTA Level 1
119
BB
Feat#1
1990 BP
188
Gravel Lens 1
194
?
FT
FT
Not Screened
LTA Level 2?
F
BB
LTA Level 3 3000 BP
LTA Level 4 3080 BP
32EM72.167
32EM72

Bone Taxa	* Flakes	* 1/4" Bone	Tool Types	* 1/16" Bone
Z	9	9	Z	9
Z	9	9	Z	9

Bone Taxa :

B : Beaver

F : Fish

Ⓕ : Lots Of Fish

FA : Fetal Antelope

G : Grouse

BB : Bison

Tool Types:

BF : Biface

C : Core

FT : Flake Tool

HS : Hammer Stone

Cultural Level

82

103 Paleosol

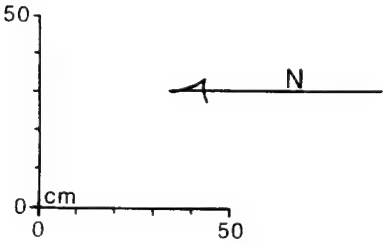
LTA Level 1

1990 BP

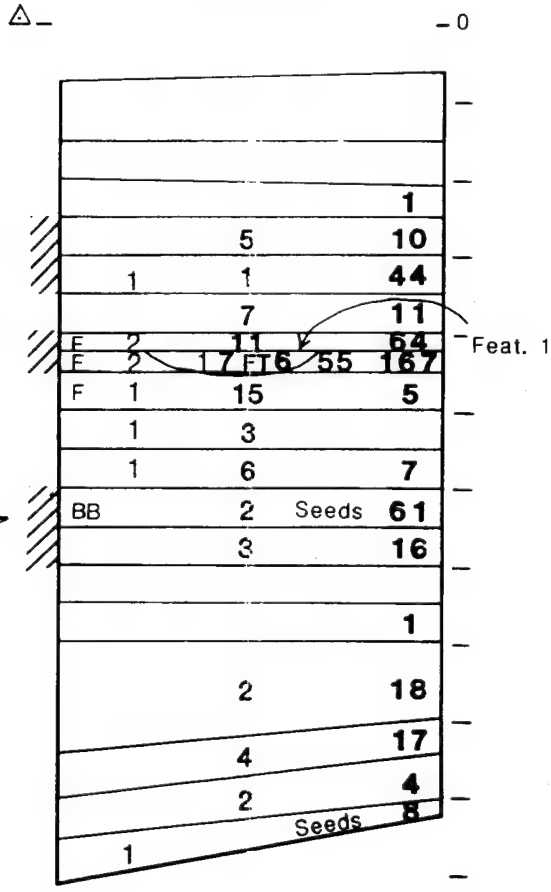
188 Gravel Lens 1

?

LTA Level 2?



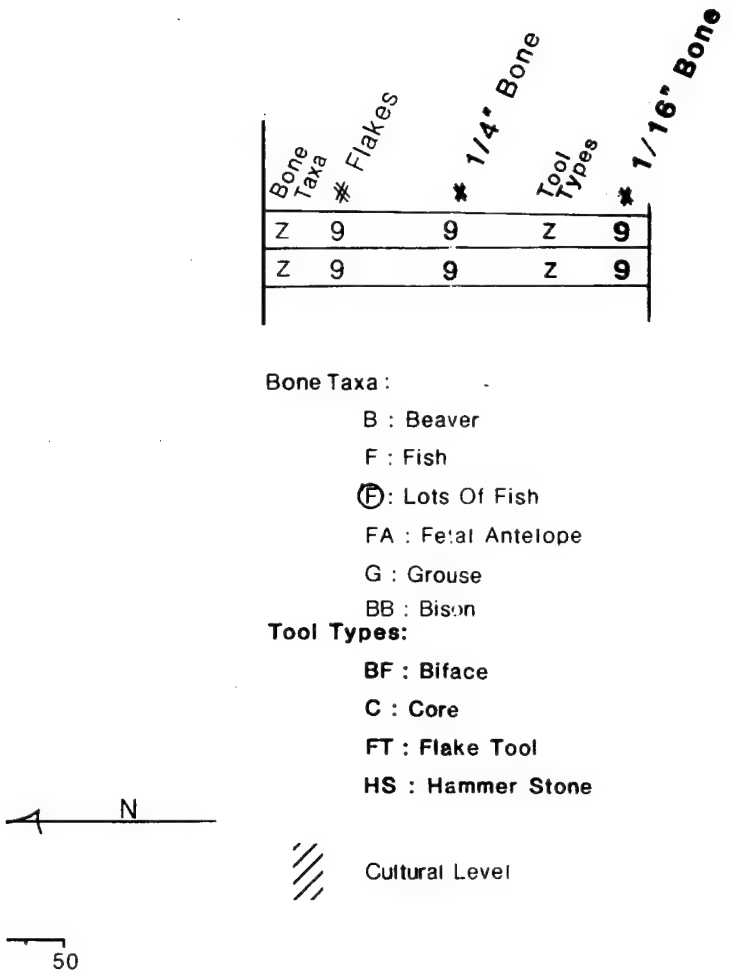
Test Pit 3



LTA Level 3

0 1cm

32EM72.167 32EM72.168



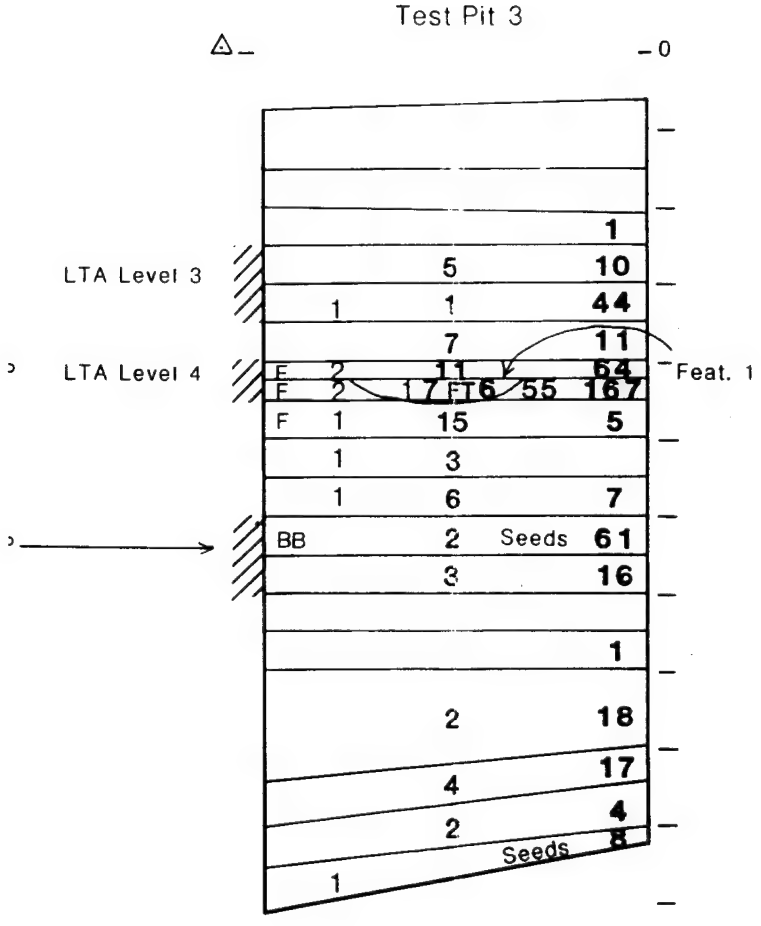
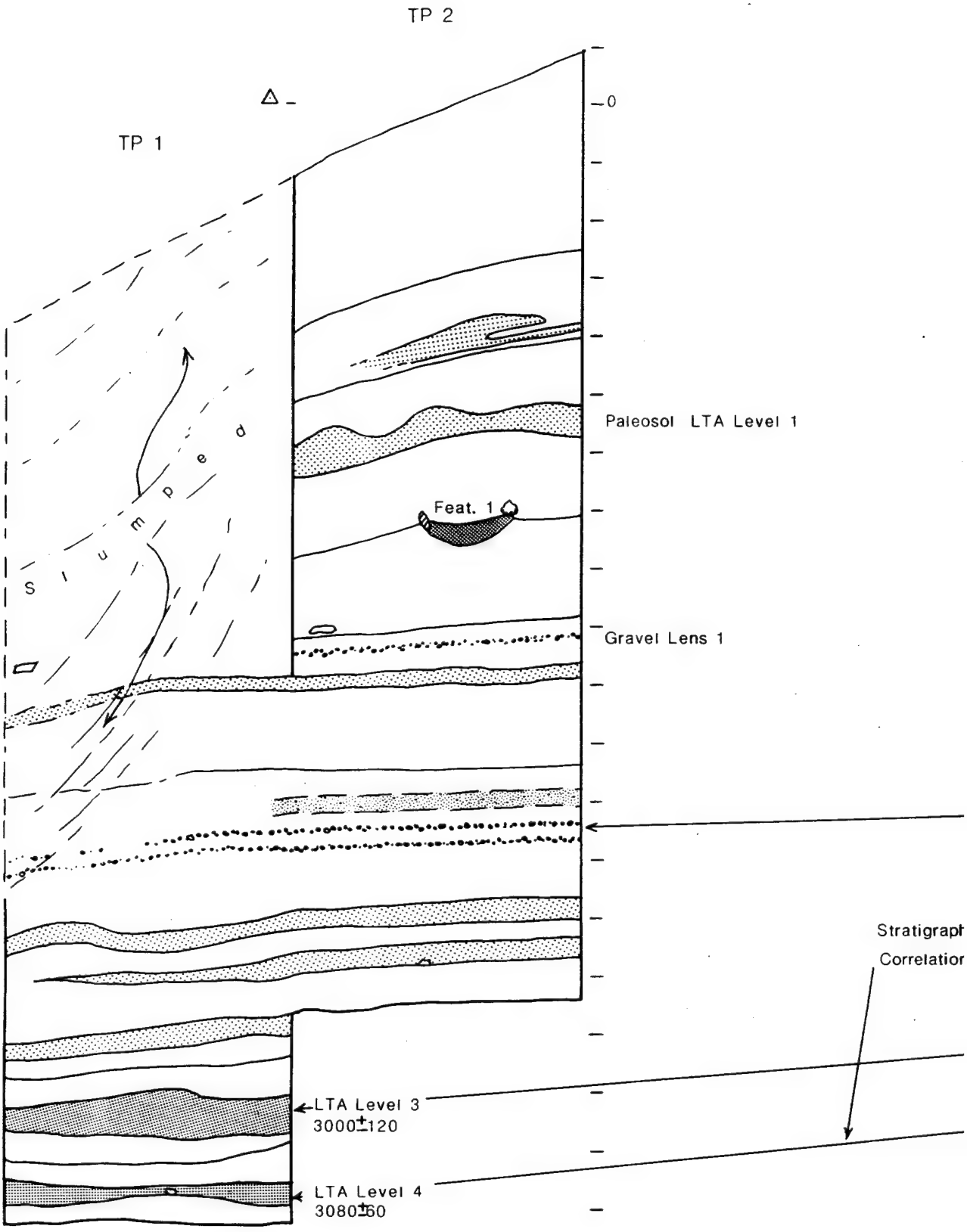
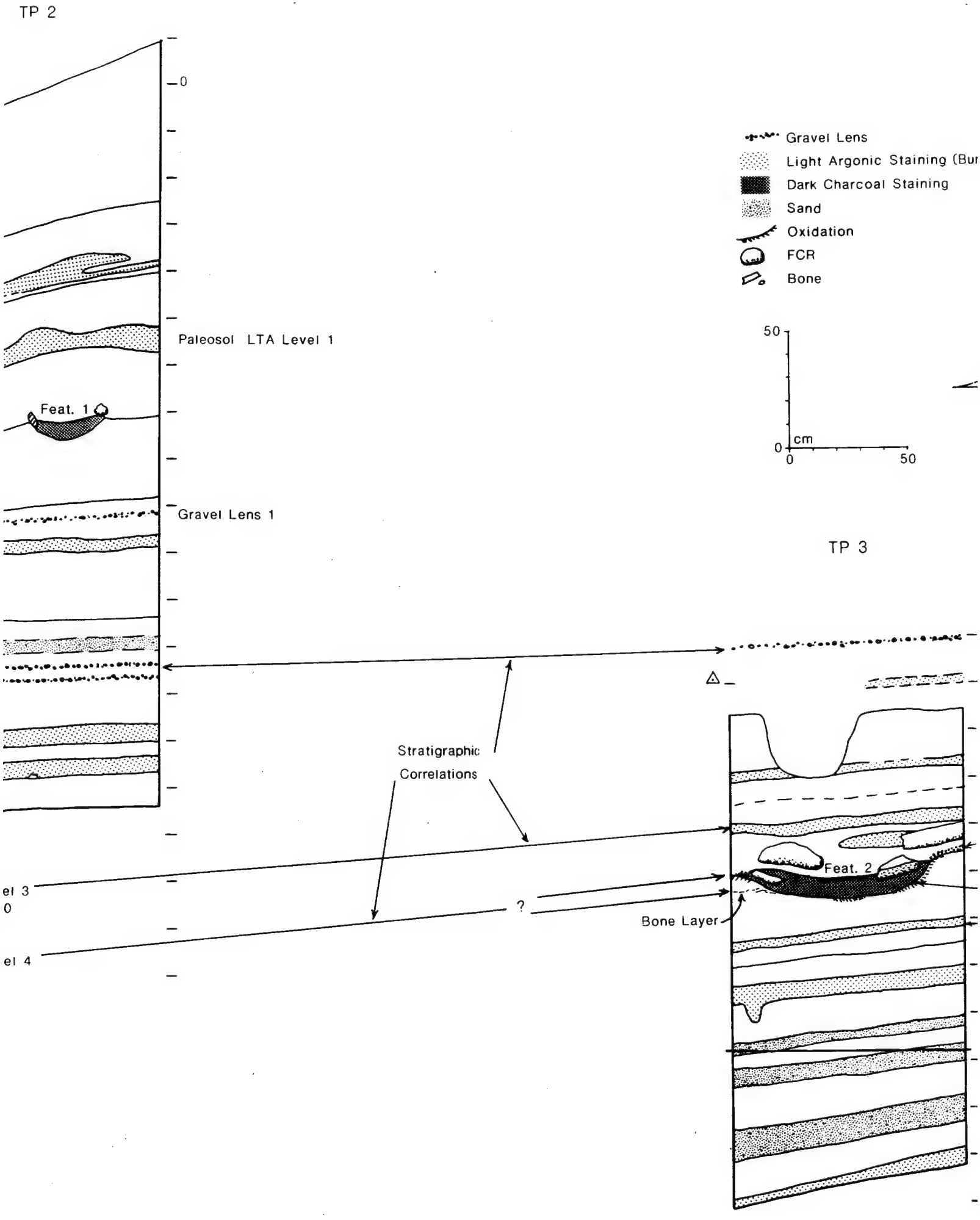
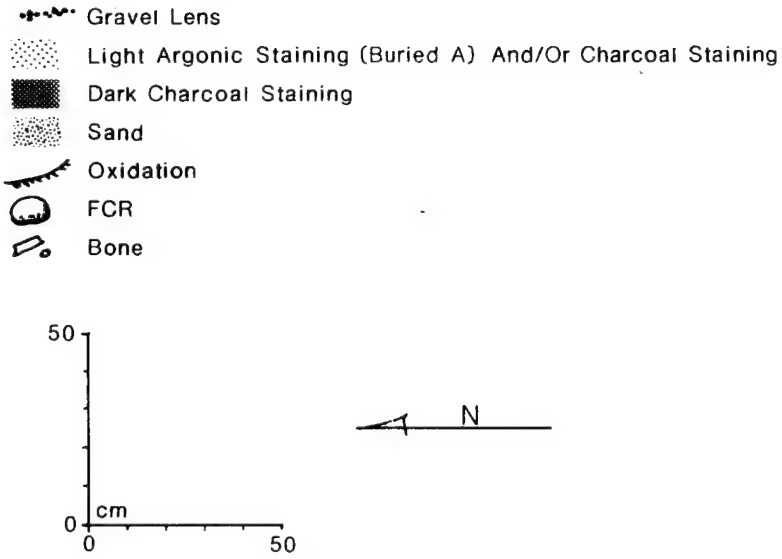


Figure 8 Backplot of artifacts from TPs 1, 2 and 3


TP 2
TP 1
0
Paleosol LTA Level 1
Feat. 1
Gravel Lens 1
S l u m p e d
Stratigraph
Correlatior
LTA Level 3
3000±120
LTA Level 4
3080±60


TP 2
0
Paleosol LTA Level 1
Feat. 1
Gravel Lens 1
el 3
0
el 4
Gravel Lens
Light Argonic Staining (Bur
Dark Charcoal Staining
Sand
Oxidation
FCR
Bone
50
0
cm
0
50
TP 3
Stratigraphic
Correlations
Feat. 2
?
Bone Layer



TP 3

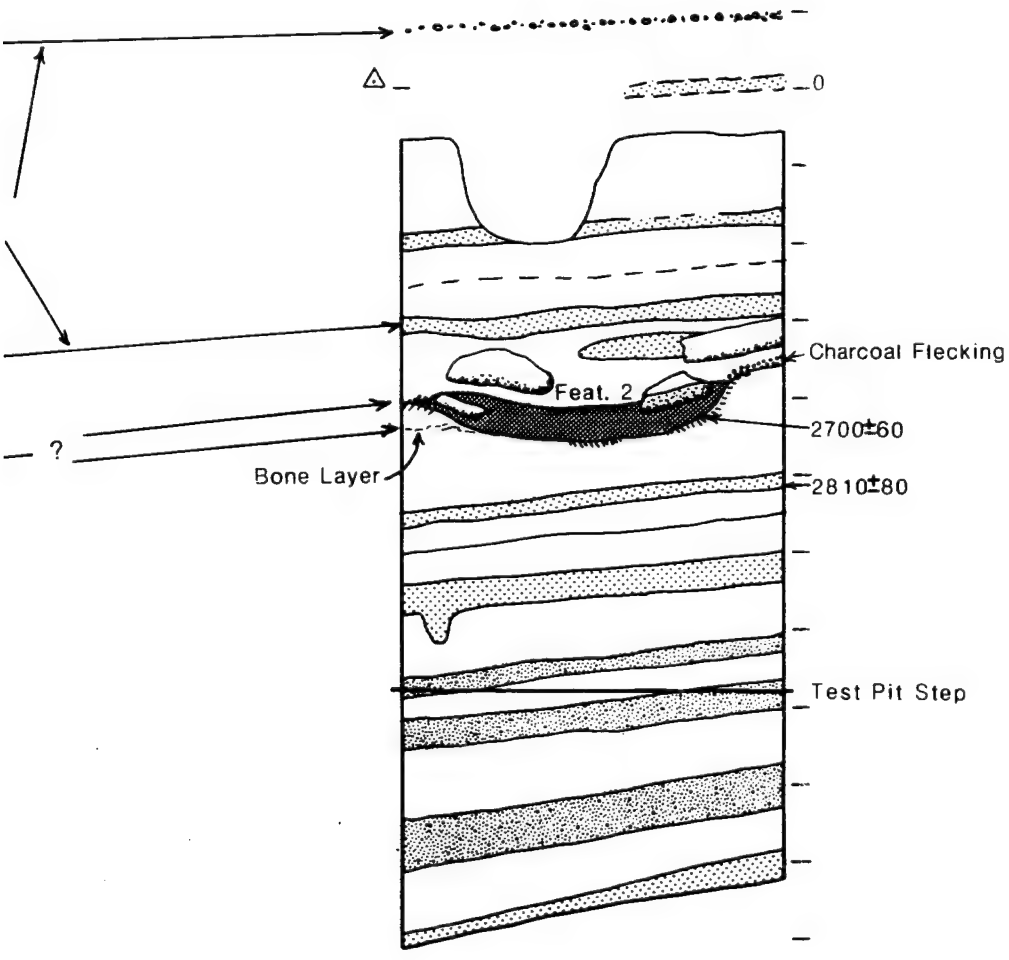


Figure 9 Profiles of TPs 1, 2 and 3

LTA Level 1 is a well-defined buried A horizon that is traceable across the entire cutbank (Figure 9 and profile, back pocket), and can also be seen in the cutbank on the north side of the gully north of the testing area. LTA observed a hearth in the horizon in 1982, but this was gone by the time MAC returned to the site in 1993. Excavation proceeded through the upper parts of this soil in both TP 1 and 2, with only minor increases in the recovery of bone but including one of the few bison elements. Pedological analysis indicates that LTA Level 1 and the top of the buried paleosol (top of Loess Unit V) is a stripped surface which might account for the concentration of cultural materials at this level. However, the reported presence of an intact feature (Larson et al. 1983) suggests that the cultural materials retain at least some integrity.

The second cultural level is approximately 40 cm below the top of the LTA Level 1 buried A horizon and is indicated primarily by Feature 1. This small basin hearth occurs in the lower part of the buried A horizon and is not associated with the paleosurface on which the A horizon formed. No increase in artifacts occurred with this feature. Feature 1 returned a date of 1990±60 BP (Beta-67850). This date is from bulk soil (no charcoal could be recovered from the feature) so it should be considered a minimum age.

The third cultural level is indicated by increased bone counts and several pieces of FCR that were recovered at about 190 to 210 cmbd in TP 2, immediately below the gravel lens (Gravel Lens 1) used to control the excavation levels for the lower part of the test pit.

The fourth level is LTA Level 2. It lies about 110 cm below LTA Level 1 and was marked primarily by a hearth eroding from the cutbank (Larson and Treat 1982). During the 1993 testing, this hearth was not found and is presumed to have sluffed off the cutbank in the interim. The only evidence of the cultural level is a small increase in bone, including bison and fish, in excavation levels at about 105 to 125 cm below the LTA Level 1 paleosol or about 220-240 cm bd (30-50 cm below Gravel Lens 1 [cmbg1]).

At about 90-100 cmbg1 in TP 2, and in the adjoining TP 1 levels at 290-310 cm bd, the fifth level is in evidence by high bone counts, including bison and fish.

The sixth cultural level is LTA Level 3. This level is clearly seen in TP 1 where it was encountered at about 350-360 cm bd. It is also traceable to TP 3 where it appears as a slightly charcoal and\or organic stained horizon with inflated counts of bone fragments. In TP 1, the level can be best described as a midden. The stratum is heavily ash-stained, contained numerous pieces of FCR, over 500 bone fragments, over 100 pieces of debitage, a hammerstone and a core. Bison and fish are both present in the faunal assemblage. Immediately below this level in TP 1, the two projectile points were recovered. Their association with either this level or the underlying level (LTA Level 4) is uncertain. Charcoal from the midden was collected by LTA and returned a date of 3000±120 (Beta-6438) (Larson et al. 1983).

The LTA Level 4/Feature 2 component is the seventh. In TP 1 it occurs about 5 to 30 cm below LTA Level 3, at about 365-390 cm bd. It contains, in TP 1, about 2500 bone fragments, over 750 pieces of chipped stone debitage, a biface, five flake tools and several

pieces of FCR. The faunal materials included butchered beaver elements, fetal antelope, and abundant fish bone. No bison was found. The stratum lacks the ashy fill that characterized the level above, but is traceable laterally to TP 3 where it is manifested by Feature 2. Interestingly, the Feature 2 basin was excavated through a thin bone level about 8 cm below the Feature 2 surface. In fact, a long bone fragment from the bone bed protruded into the basin of the hearth and is scorched on that end. This indicates that at least two occupations are present in this level in TP 3, but the correlation of one or both with the level in TP 1 is uncertain. Two radiocarbon dates were received from this level: 2700±60 (Beta-67847) comes from Feature 2 and 3080±60 (Beta-67846) was returned on charcoal from the level in TP 1.

In TP 3, the top of Loess Unit I is suggested to be a stripped surface. This contact occurs between Feature 2 and the underlying cultural level. The integrity of Feature 2, the bone bed truncated by the feature basin, and the midden deposit which manifests this level in TP 1, suggests that the cultural materials were deposited after erosion had ceased and shortly after aggradation had resumed.

The eighth and deepest documented level occurs in TP 3 at about 120-140 cm bd or about 30-50 cm below Feature 2. Bison bone and increased bone counts were found here. Tracing the horizon laterally to the south, a hearth feature was found eroding from the cutbank. This feature was not excavated, but charcoal was removed from it and returned a date of 2810±80 (Beta-67849).

Somewhere on the cutbank is a cultural horizon containing ceramics. Several fragments were noted in the cutbank slump in the vicinity of TP 3. These were not collected because their context was lost. The ceramics give indication of a cultural level high on the cutbank, but this level was not identified in excavation. Some of the ceramics collected by Ralph Thompson from the surface of this site have been identified as Avonlea parallel-grooved (Johnson 1992). Dates for Avonlea ceramics are AD 100 to AD 1000 (Johnson 1992, citing Morlan 1988) or ca. 1850-950 BP.

Within each test pit, the radiocarbon dates are in stratigraphically correct position. However, when the natural and cultural stratigraphy is traced between test pits, Feature 2 is below the LTA Level 3 midden, and the buried A horizon below Feature 2 is below LTA Level 4. The stratigraphic situation is seen best in Figure 10 where the LTA Level 3 midden stratum can be traced laterally from TP 1 to TP 3 where it occurs about 20 cm above Feature 2. The distribution of fish bone supports this interpretation. The apparent reversal of radiocarbon dates is tempered by consideration of the two-sigma age range, and allowing for the possibility of use of old wood or pieces of wood from larger trees for fuel.

Thompson Collection

Ralph Thompson has a fairly extensive collection of chipped stone tools, worked bone, worked stone, and ceramics collected from this site. While MAC was in the field, he brought these artifacts to the site for examination. Photographs were taken of selected examples, including the diagnostic projectile points and some of the worked bone and stone

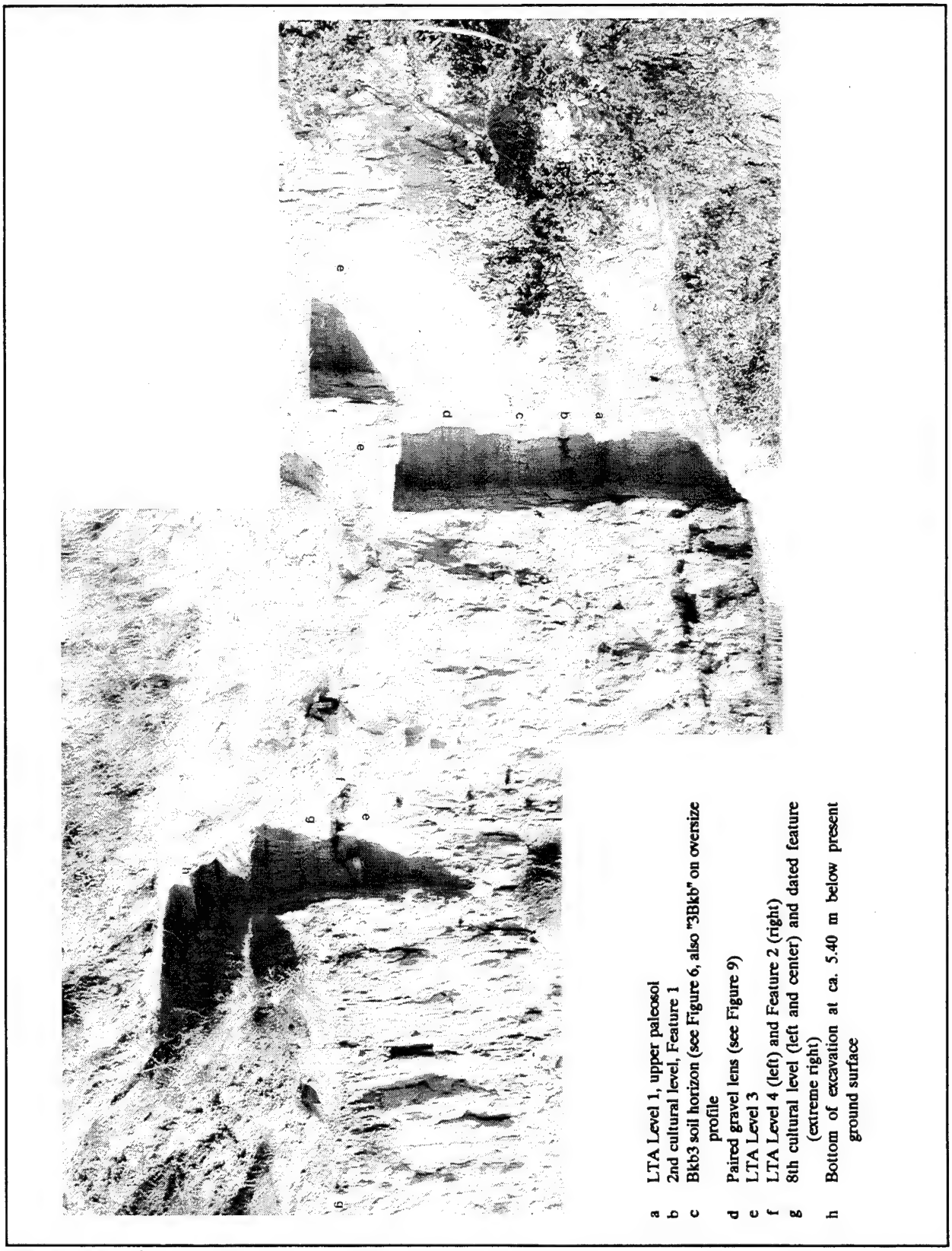


Figure 10 Composite photo of TPs 1, 2 and 3 profiles

(Figure 11), and several ceramic fragments including a partially reassembled vessel (Figure 12).

Most of these materials come from elsewhere on the site. Some were collected from the intact ground surface shoreward of the cutbank in the north part of the site, and some were collected from the beach below the cutbank during lower water. Only the bone awl and the bone fish hook were recovered in the area of test excavations. These two artifacts were both removed from LTA Level 3 (Ralph Thompson, personal communication 8/17/93; Thompson and McDonald 1990).

DISCUSSION

The test excavations at 32EM72 succeeded in providing additional information regarding the dates and nature of later occupations of the site. Materials from a private surface collection provide additional information on other occupations. Geomorphological and pedological studies supplement the excavation information by providing an idea of the potential lateral extent of cultural levels encountered in the cutbank.

Paleoindian

The only Paleoindian manifestations from this site are several projectile points collected by Ralph Thompson. One is a complete Eden point featured in the state comprehensive plan (SHSND 1990:5.30[e]). Mr. Thompson reports that it came from the northern part of the site. Two other Paleoindian artifacts include a base fragment and a complete stemmed point; both may be Alberta, although the complete point also resembles Pryor Stemmed.

Paleoindian occupation of the site is probable given these three artifacts, although prehistoric curation is also a definite possibility. The presence of intact Paleoindian levels, however, is undocumented and the geomorphological studies suggest it unlikely that intact early Holocene deposits are present on the landforms of the site area.

Plains Archaic Periods

The Plains Archaic is usually divided into Early, Middle and Late periods and is typified by a diversity of resource utilization not seen in the previous Paleoindian period and by a concurrent diversity of tool types and notched projectile points.

Early and Middle Archaic materials are not known from 32EM72. The potential for either is present, although stronger for Middle than Early Archaic.

The Late Plains Archaic (somewhat synonymous with Pelican Lake in this area) is the best represented period in the excavations. Four radiocarbon dates from the test pits and features in the cutbank are Late Plains Archaic in age. LTA Levels 3 and 4, and the underlying level that produced the radiocarbon date of 2810 BP, are Late Archaic. Several

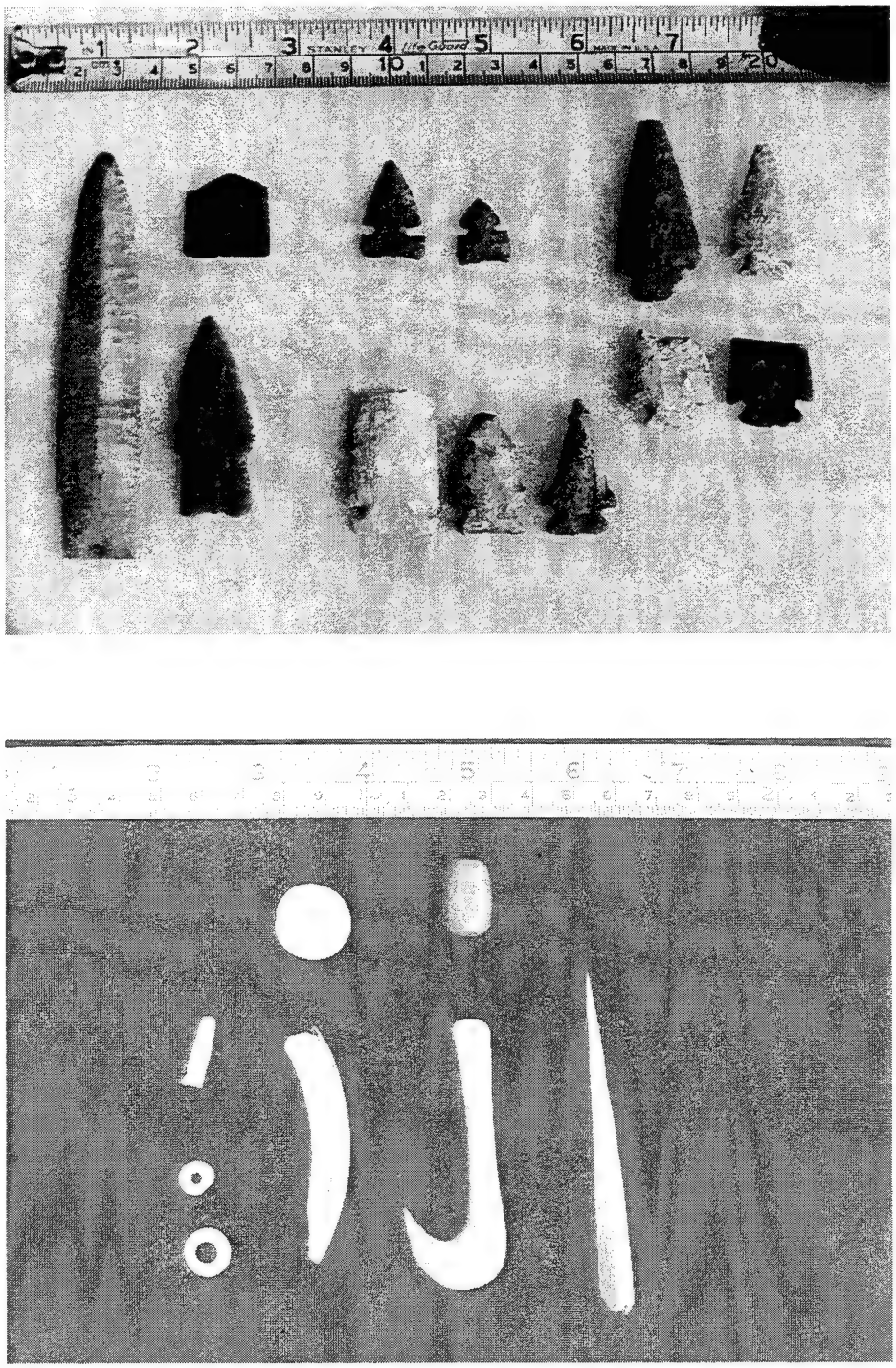


Figure 11 Selected projectile points, worked bone, and worked stone artifacts from Ralph Thompson's collections

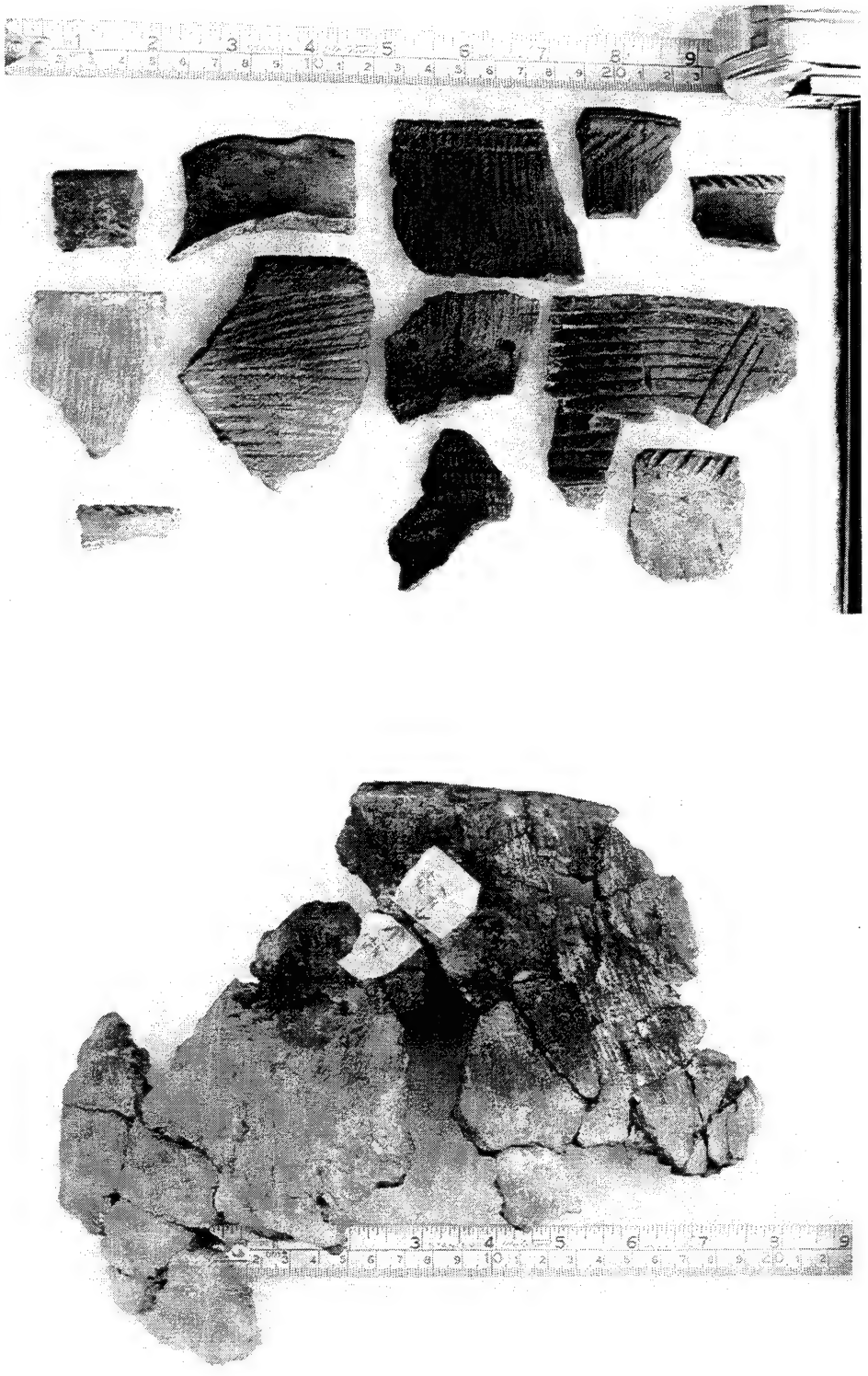


Figure 12 Selected examples of ceramics, and a partially reassembled vessel from Ralph Thompson's collections

of the projectile points in Ralph Thompson's collection from this site are typical of the Pelican Lake type.

Plains Woodland Periods

Plains Woodland, like Plains Archaic, is divided into Early, Middle and Late. Plains Woodland is generally considered the successor to Plains Archaic, but in some cases, especially farther west, there is overlap between the terminal Plains Archaic and initial Plains Woodland. During the Plains Woodland periods, ceramics, horticulture, and burial mound mortuary practices are first found. Point styles such as Avonlea, Besant and Sonota, along with cord-roughened ceramics are indicators of Plains Woodland.

At 32EM72, Plains Woodland is in evidence through projectile points, ceramics, and one radiocarbon date. The contexts of several of these finds appear to be too old based on radiocarbon dates and accepted age ranges. A Timber Ridge Side-notched point was recovered in TP 1 between LTA Level 3 and LTA Level 4 which date respectively to 3000 BP and 3080 BP.

Avonlea ceramics (Johnson 1992) and other varieties, including cord-roughened, have been recovered from the site but not from excavated contexts. Ceramics were present on the cutbank slump in front of the excavation areas. It is possible that the ceramics are associated with the Feature 1 occupation (1990 BP) or with LTA Level 1. Unfortunately, no ceramics were recovered in the test excavations.

Radiocarbon Dates

Five radiocarbon dates have been run on charcoal and soil samples from 32EM72. These are: 1990±60 (Beta-67850), 2700±60 (Beta-67847), 2810±80 (Beta-67849), 3000±120 (Beta-6438), and 3080±60 (Beta-67846). The first was run on a bulk soil sample from Feature 1 and should be considered a minimum age. The remainder are charcoal dates.

These dates appear generally acceptable. Within individual test pits, they occur in correct stratigraphic order. The reversal of dates in the lower cultural levels in TP 1 and TP 3 might be attributed to the statistical vagaries of the date (all but the two most divergent dates overlap at two sigmas). A potential second source of skewing is the use of old wood, or wood from larger limbs of trees available on the Missouri floodplain and the nearby woody draws. Driftwood was likely plentiful in the immediate area also and might have been of some antiquity when collected.

Settlement and Subsistence

Data sufficient to discuss settlement and subsistence was recovered only from LTA Level 3 and LTA Level 4/Feature 2. Both are Late Archaic and can be characterized as midden deposits with abundant chipped stone artifacts and bone scrap. LTA Level 3 had considerable quantities of ash and FCR in the midden layer and the presence of a nearby hearth, or hearths, is suspected although it is possible that associated features have been lost

to cutbank erosion. LTA Level 4 is likely associated with Feature 2. Bone scrap recovered from these two cultural levels indicate use of a relatively diverse fauna.

Taxa that were definitely exploited include antelope, bison, beaver, and fish including catfish. Antelope is the most numerous in terms of individual pieces of bone and it is very likely that most if not all of the deer/sheep/pronghorn size category is antelope; only one deer bone was recovered, and no sheep. It is also very probable that all or nearly all of the elk/bison size category is bison. Bison remains are interesting in that they are scattered throughout a number of levels that are otherwise unremarkable.

Fish are most common in LTA Level 4 and near Feature 2, and some are large. The bone fish hook collected by Ralph Thompson from the cutbank was recovered from LTA Level 3 in the TP 1 area. The fish hook itself is a fairly large item. The beaver is confined to LTA Level 4. At least two animals are represented and cut marks were noted on several of the elements. Bison is found in LTA Level 3, and in other levels throughout the excavation, including what may be LTA Levels 1 and 2. No bone keyable to bison comes from LTA Level 4 although several pieces in the elk/bison size category were found at Feature 2.

Antelope provides the most intriguing information. Bones keyed to the pronghorn taxon are primarily confined to LTA Level 4 and to the Feature 2 area, especially in the bone level truncated by the feature basin. The collection from TP 1 in LTA Level 4 includes 24 fetal elements from at least three individuals. A winter occupation is almost certainly in evidence.

The deer, grouse and fox, each represented by one or two bones, are questionably of cultural origin. The deer bone was recovered from the fill of Feature 2 but was unburned. Fox, especially Swift Fox, is noted in other archaeofaunas and in the regional ethnographic record. The single fox bone (a mandible fragment) was recovered from LTA Level 4. Foxes are very curious and known to approach humans with little fear. They are also scavengers and may have been attracted by the evidently intensive level of meat and bone processing occurring at that time. The grouse are more likely to be a natural occurrence. The two unburned and unmodified grouse bones were found high in TP 1, in a level unremarkable for its cultural content.

Mouse, vole, pocket gopher, snake and small bird are almost certainly intrusive. None of these bones were burned and all occur in levels that had little other cultural evidence.

The high percentage (88.2%) of bone identified only to the more general size categories (large mammal, mammal, and indeterminate) is indicative of intensive bone processing for marrow extraction and rendering of bone grease (Vehik 1977). This is evident in both LTA Levels 3 and 4.

Floral materials recovered include a number of seeds, seed fragments and other plant parts. These were removed from fine screen samples, rather than by flotation, and should

not be considered a systematic sample. The recovered remains are informative, however. Hackberry, chokecherry and wild grape are present. An unidentified grass is also possibly present. Some of the seeds from all taxa are burned. Their charred condition suggests purposeful exploitation of these resources.

Settlement patterns are not interpretable from such a small excavation sample, but site function can be addressed and can contribute to larger scale settlement analysis. Both LTA Levels 3 and 4 are indicative of short to medium term processing loci. In Binford's terminology (1980), there is not the intensity of activity, nor the features to assume the site is a collector's residential base or field camp. However, this may be purely a function of sampling; middens are often associated with residential and camp sites. The concentration of cultural materials does indicate activities focusing on bone processing and butchering, along with lithic reduction, and as such these two levels might be locations where a task-oriented group procured and/or processed faunal materials engaged in flintknapping. In pre-Lake Oahe days, and especially considering the ground surface would have been considerably lower in this small draw, the location would have been quite sheltered by the sandstone ridge visible in the cutbank to the south. But it also has a north aspect, and given the winter occupation indicated in LTA Level 4, it is fairly unlikely that LTA Level 4 is a camp. Overlook potential of the nearby buttes and knolls, especially of the river valley, and north into the Beaver Creek drainage, would have been good. Access to the resource diversity found in the Missouri River, the valley floor and the nearby uplands would also have been easy.

Geoarchaeology

The morphology of soil-stratigraphic units, the size (loess) of the sediments exposed in the cutbank, the position of these sediments in the lee of a rock outcrop, and their late Holocene age suggest that the culture-bearing strata at 32EM72 are wind deposited. Such an origin also indicates that cultural materials buried within these deposits will be *in situ*. However, the profile does exhibit evidence of erosion that is associated with the end of cycles of loess deposition. These erosional events act to compress archaeological components on an erosion surface. Overall, the presence of numerous weak, organic enriched soil A horizons within all but one of the individual loess units suggests periods of concurrent deposition and organic enrichment probably under mesic climatic conditions. In turn, the presence of stripped calcareous paleosols on the upper margins of the loess units suggests comparatively xeric climatic conditions. This proposal of wet = deposition and dry = erosion is contrary to the late Holocene model of Clayton et al. (1976) who propose eolian deposition to be the result of dry climatic events. Interestingly, the rate of loess deposition has decreased dramatically in the last ca. 3000 years from 0.28 cm/yr (2810 to 2700 BP), 0.26 cm/yr (2700 to 1990 BP), to 0.097 cm/yr (1990 BP to present AD 1993).

The results of the coring program suggest that limits of intact subsurface cultural remains at 32EM72 may extend well beyond the cutbank, possibly as far east as a point near the COE property line. However, the exact potential of these sediments is unknown due to an absence of absolute dating. The position of dated cultural materials exposed in the cutbank suggests that the site may date somewhat greater than 3000 BP. Also, the

increasing rates of sedimentation, depth (ca. 5 m below surface) to the 3000 BP cultural materials, and sequence of deposition hint that the site post dates the Altithermal. However, this is a tentative assessment since Late Paleoindian points have been recovered at the base of cutbank north of the tested area of the site. It is possible that lower segments of the cutbank presently buried by talus and/or driftwood, or below the lake level, may yield sediments/soils dating to the early Holocene. If such levels are present and if the dry = erosion model is valid, then it is probable that cultural materials may be compressed upon an Altithermal erosion surface.

32EM72 is perplexing in its complexity. It is a deeply (>5.5 m) stratified, multicomponent site whose boundaries may extend to the border of the Corps of Engineers property line and one exhibiting a loess matrix that favors the preservation of the environmental record and the *in situ* burial of cultural materials. Two perplexing aspects are the susceptibility of the loess matrix to erosion and what type of remediation to recommend. Rip-rapped sites like Walth Bay and Travis 2 in South Dakota are good examples of attempts to preserve site integrities that have failed or been only marginally successful. Cost is an important factor in that either adequately lined rip-rapping or full scale mitigation are expensive. Compounding the problem is time. The ephemeral nature of a loess bluff exposed to wave erosion is no secret.

RESEARCH POTENTIAL

The research potential at 32EM72 is high and has been only partially tapped by this project. Several cultural levels spanning the last 3000 years are documented and are well sealed in loess deposits. Evidence of post-depositional disturbance is very limited except at the face of the cutbank, where bank-burrowing birds and rodents have created tunnels and small nest areas. Preservation is good for an open site, again probably largely due to the depositional matrix and its rapid aggradation. The excavations conducted to date have probably only nicked the tip of the iceberg at this site. Although an unknown and perhaps substantial portion of this part of the site has been lost due to wave action erosion on Lake Oahe, there is reason to believe that the cultural levels identified extend into the intact deposits for some distance.

Among the specific questions listed in the state plan for the Southern Missouri River Study Unit (SHSND 1990:5.1-5.51), the following questions and tasks are addressable with data documented at the site:

- Chronological studies are needed to see if the chronology of Archaic complexes in the Middle Missouri subarea differs from the Archaic chronology used statewide.

- Attempts need to be made in correlating Archaic functional site types with landforms in order to begin modeling settlement behavior.

- What forms of archaeologically recoverable evidence for seasonality can be expected in Plains Archaic deposits in this part of North Dakota?

- As suggested for southwestern Manitoba, do the larger "Archaic Barbed" corner notched forms date to the earlier part of the Late Archaic period while the smaller "Plains Middle Woodland Pelican Lake points" date to the later part of the period?

- North Dakota archaeologists should work with Omaha Corps of Engineers cultural resource specialists to develop test excavation programs at shoreline sites in the "take area" along Lake Oahe.

- What sorts of site depositional contexts are most likely to hold artifacts and ecofacts with highest potentials to yield important information concerning Woodland environmental conditions?

- Are Early Plains Woodland components in this Study Unit sufficiently similar to those from the James River Study Unit to indicate a cross-subareal development of an Early Woodland culture from a single Pelican Lake complex which was distributed across portions of the Northeastern Plains and Middle Missouri subareas?

- Where else within the Study Unit can pre-Formative Plains Village Late Woodland components be identified?

- What are the technological attributes of transitional Early-to-Middle Woodland and Middle-to-Late Woodland ceramics in this area?

- What artifact styles are diagnostic of Early and Late Woodland components in this Study Unit?

Without question, this site has information to contribute to these topics and others. The presence of an Avonlea projectile point at 3000-3080 BP is worth further exploration, as is the presence of both the point and Avonlea ceramics this far southeast along the Missouri River. Gregg (1987b) has observed that small, usually corner-notched, points do occur in regional late Plains Archaic contexts. Metcalf and Black (1985) go on to suggest that perhaps early experimentation with bow-and-arrow technology during Pelican Lake times may be worth considering. Reeves' (1983) assertion that Avonlea succeeds Pelican Lake leaves room of co-occurrence of these two point types during times of transition.

RECOMMENDATIONS

This site is being rapidly lost to lake shore wave action. An unknown amount is already gone, and an unknown amount remains. At the time of fieldwork, the water level was less than 3 m below the lowest cultural material found in excavations and was rising. The historic high water line, indicated by a "bathtub ring" of driftwood, is less than one half meter below the lowest known cultural material. There has been significant sluffing of the cutbank since the site was first recorded in 1982. The integrity of substantial parts of the northern site area is lost. Gnabasik expanded the site considerably to include bone and lithics found on the beach during low water in 1986. No evidence could be found in 1993 that intact materials remained above water in the northern site area.

The site is unquestionably eligible for inclusion on the National Register of Historic Places. It is also without question that portions of the site containing data that contribute

or could have contributed to this eligibility have been and are actively being eroded by higher water levels in Lake Oahe.

It is strongly recommended that immediate action be taken to either stabilize the bank in the area of test excavations, and/or that a data recovery program be implemented to recover the remaining cultural materials before they are lost.

POSSIBLE TREATMENTS

In order to either prevent or mitigate the effects of further erosion of the signficant cultural deposits, several alternatives are apparent. One option is to attempt to stabilize the bank and prevent further erosion. This has been tried with marginal success at other sites, as noted above. At 32EM72, bank stabilization will be hampered primarily by the height of the cutbank (10 m above water level at the time of this fieldwork) and by the need to bring in considerable amounts of material to fill in behind any stabilization structure erected in front of the cutbank. These efforts will likely require use of heavy equipment, which, that close to the cutbank, poses its own threats of damage to the site, in addition to the obvious safety concerns.

The other option is to proceed with a data recovery plan and to systematically excavate a reasonable sample of the deposits that are at and close to the cutbank. Data recovery excavations will be an intensive undertaking, given the depth to which they must reach. To enhance cost and time efficiency, any data recovery involving excavation should proceed with a well thought-out strategy for identification and subsequent removal of sterile overburden with heavy equipment. Some techniques and strategies which might prove useful and informative include:

- Additional coring as part of a coring/dating program to refine the age and potential of the locality's loess deposits.
- Use of ground penetrating radar to attempt to identify features, concentrations of burned rock or other rocks in order to guide placement of excavations.
- Use of auger probing supplemented by 1 sq m test pits to assist in identification of sterile overburden.
- Full time, on-site geoarchaeological consultant to guide further interpretation of deposits, sediments and depositional contexts of discovered cultural material.
- Additional investigations, including pedological analysis, radiocarbon dating, palynology, and possible phytolith analysis, to refine the paleoenvironmental sequence.

References Cited

Ahler, Stanley A.
1986 *The Knife River Flint Quarries: Excavations at Site 32DU508.* State Historical Society of North Dakota, Bismarck.

Binford, Lewis R.
1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

Birkeland, Peter W.
1984 *Soils and Geomorphology.* Oxford University Press, New York.

Clayton, Lee
1976 *Notes on Pleistocene Stratigraphy of North Dakota.* North Dakota Geological Survey Report of Investigation 44, Bismarck.

1980 *Geologic Map of North Dakota.* United States Geological Survey, Denver.

Clayton, Lee, S.R. Moran, and W.B. Bickley, Jr.
1966 *Stratigraphy, Origin, and Climatic Implications of Late Quaternary Upland Silt in North Dakota.* North Dakota Geological Survey Miscellaneous Series No. 54, Bismarck.

Clayton, Lee, S.R. Moran, and J.P. Bluemel
1980 *Explanatory Text to Accompany the Geologic Map of North Dakota.* North Dakota Geological Survey Report of Investigation 69, Bismarck.

Coogan, Alan H.
1960 Geological Age of Soldier Creek Buffalo County, South Dakota. *Iowa Academy of Science* 67:314-325.

Gnabasik, Virginia
1986 Site form update for 32EM72 (3/6/86). On file, State Historical Society of North Dakota, Bismarck.

Gregg, Michael L.
1987a (editor) *Archaeological Excavation at the Naze Site (32SN246).* Department of Anthropology, University of North Dakota, Grand Forks. Submitted to USDI Bureau of Reclamation, Contract No. 4-CS-60-00630.

Gregg, Michael L.
1987b Stone Tools and Manuports from the Naze Site. In *Archaeological Excavation at the Naze Site (32SN246)*, edited by Michael L. Gregg, pp. 231-302 (Chapter 8). Department of Anthropology, University of North Dakota, Grand Forks. Submitted to USDI Bureau of Reclamation, Contract No. 4-CS-60-00630.

Johnson, Ann M.
1992 New Information on Avonlea Ceramics. Paper presented at the Fiftieth Annual Plains Anthropological Conference, November 11-14, 1992. Lincoln, Nebraska.

Krumbein, W.C., and Sloss, L.L.
1963 *Stratigraphy and Sedimentation*. 2nd ed. W.H. Freeman, San Francisco.

Larson, Thomas K., and Pat Treat
1982 Site form for 32EM72 (6/29/82). On file, State Historical Society of North Dakota, Bismarck.

Larson, Thomas K., Kurt P. Schweigert, Stephen A. Chomko, and W. Raymond Wood
1983 A Cultural Resource Inventory of Proposed Recreation Areas, Lake Oahe: Emmons, Morton and Sioux Counties, North Dakota. Volume I. Larson-Tibesar Associates, Laramie, Wyoming. Submitted to US Army Corps of Engineers, Omaha, Nebraska, Contact No. DACW45-82-M-1985. Ms. on file, US Army Corps of Engineers, Omaha District office.

Lyman, R. Lee
1979 Available Meat from Faunal Remains: A Consideration of Techniques. *American Antiquity* 44(3):536-546.

MAC (Metcalf Archaeological Consultants)
1993 Scope of work submitted with proposal for Contract No. DACW45-93-P-1218. On file, Omaha District Office US Army Corps of Engineers, Omaha.

McFaul, Michael
1985 Early and Late Wisconsin Age Missouri River Fill Terraces in South Dakota. *Current Research in the Pleistocene* 2: 125-126.

McFaul, Michael, Doering, W.R., and Zier, C.J.
1991 Late Pleistocene-Early Holocene Soil-Sediment Relationships on the Kersey Terrace, Northeastern Colorado. *Current Research in the Pleistocene* 117-119.

Metcalf, Michael D., and Kevin D. Black
1985 Archaeological Investigations at Three Sites in the North Cave Hills, Harding County, South Dakota. Metcalf Archaeological Consultants, Eagle, Colorado, and Archaeological Energy Consulting, Casper, Wyoming. Prepared for Mosbacher Production Company, Houston. Ms. on file, State Historic Preservation Office of South Dakota.

Reeves, Brian O. K.
1983 *Culture Change in the Northern Plains: 1000 B.C.-A.D. 1000*. Archaeological Survey of Alberta, Occasional Paper No. 20. Edmonton, Alberta.

Root, Matthew J., Michael L. Gregg (editors)
1983 *Archaeology of the Northern Border Pipeline, North Dakota: Survey and Background Information.* University of North Dakota, Department of Anthropology and Archaeology, Contribution 194. Prepared for Northern Border Pipeline Company, Omaha.

SHSND (State Historical Society of North Dakota)
1990 *The North Dakota Comprehensive Plan for Historic Preservation: Archaeological Component.* Archaeology and Historic Preservation Division, State Historical Society of North Dakota, Bismarck.

Sullivan, Alan P. III, and Kenneth C. Rosen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50(4):755-779.

Thompson, Ralph, and Doug McDonald
1990 Site form update for 32EM72 (9/5/90). On file, State Historical Society of North Dakota, Bismarck.

Vehik, Susan C.
1977 Bone Fragments and Bone Grease Manufacturing: A Review of Their Archaeological Use and Potential. *Plains Anthropologist* 22(77):169-182.

Way, Douglas
1978 *Terrain Analysis.* Dowden, Hutchinson and Ross, Stroudsburg, Pennsylvania.

Appendix: Profile Description

The following profile description accompanies the illustration in Figure 6, page 21. The profile was described by Michael McFaul and Karen Lynn Traugh of LaRamie Soils Service, on August 18, 1993.

DEPTH (cm)	SEDIMENT UNIT	HORIZON	CHARACTERISTICS/COMMENTS
0-7	loess VI	A	Dark grayish brown (2.5Y4/2m); massive; noneffervescent; boundary is clear, wavy.
7-63	loess VI	Bw	Dark grayish brown (2.5Y4/2m); moderate, very coarse, prismatic structure; boundary is abrupt, smooth.
63-105	loess VI	C	Light brownish gray (10YR6/2d); massive; consistence = 0.5 kg/cm^2.
105-111	loess VI	Ab	
111-120	loess VI	C	Light brownish gray (10YR6/2d); massive; consistence = 0.5 kg/cm^2.
120-122	loess VI	Ab2	
122-138	loess VI	C	Light brownish gray (10YR6/2d); massive; consistence = 0.5 kg/cm^2.
138-151	loess V	Abk	Very dark grayish brown (10YR3/2d); consistence = 0.75 kg/cm^2; possible Woodland pottery level.
151-158	loess V	Ck	Grayish brown (2.5Y5/2d); moderate, very coarse, subangular blocky structure; slightly effervescent with disseminated carbonate; consistence = 0.75 kg/cm^2.
158-168	loess V	Abk2	Dark grayish brown (2.5Y4/2d).
168-181	loess V	Ck	Light brownish gray (2.5Y6/2d).
181-191	loess V	Abk3	Light brownish gray (2.5Y5/4d).
191-198	loess V	Ck	Light brownish gray (2.5Y6/2d).
198-219	loess IV	Abk4	Pale olive (5Y6/3d); violently effervescent with common (8%), medium, rounded masses; stripped surface and possible bone bed; radiocarbon date of 1990±60 yr. BP.
219-231	loess IV	Bkb	Pale olive (5Y6/3d); moderate, medium, subangular blocky structure; violently effervescent with many (30%), fine, irregular, segregated filaments of carbonate; consistence = 2.25 kg/cm^2.
231-246	loess IV	Abk	Olive (5Y5/3d); slightly effervescent with common (9%), fine, irregular, segregated filaments of carbonate; consistence = 0.75 kg/cm^2.
246-256	loess IV	Bkb2	Pale yellow (5Y7/3d); consistence = 1.0 kg/cm^2.
256-264	loess IV	Ab3	Olive gray (5Y5/2d); consistence = 1.0 kg/cm^2.
264-289	loess IV	Bkb3	Pale olive (5Y6/3d); violently effervescent with common (8%), fine, irregular, segregated filaments of carbonate; consistence = 2.0 kg/cm^2.

289-293	sheet wash	2C	Gravel lens (5-7 mm) of sandstone; subangular to subrounded; consistence = 0.75 kg/cm^2.
293-311	loess III	3C	
311-322	loess II	charcoal	Dark olive gray (5Y3/2d); charcoal band within horizon.
322-343	loessII	3Bkb	Pale olive (5Y6/3d); weak, very coarse, subangular blocky structure; slightly effervescent with common (4%), fine, irregular, segregated filaments of carbonate; consistence = 0.75 kg/cm^2.
343-349	loess II	charcoal	Dark olive gray (5Y3/2d); charcoal band within horizon.
349-358	loess II	3Bkb	Pale olive (5Y6/3d); weak, very coarse, subangular blocky structure; slightly effervescent with common (4%), fine, irregular, segregated filaments of carbonate; consistence = 0.75 kg/cm^2.
358-365	loess II	charcoal	Dark olive gray (5Y3/2d); charcoal band within horizon.
365-379	loess II	3Bkb	Pale olive (5Y6/3d); weak, very coarse, subangular blocky structure; slightly effervescent with common (4%), fine, irregular, segregated filaments of carbonate; consistence = 0.75 kg/cm^2.
379-384	loess II	Cultural	Dark olive gray (5Y3/2d); cultural level within horizon that contains FCR and a hearth; radiocarbon date of 2700±60 yr. BP.
384-410	loess I	3Bkb2	Olive (5Y4/3d); violently effervescent with common (18%), fine, irregular, soft masses of carbonate; consistence = 1.5 kg/cm^2; radiocarbon date of 2810±80 yr. BP from top of horizon and 3000±120 yr. BP from a bone near the bottom.
410-414	loess I	3Ab	Dark olive gray (5Y3/2d); charcoal band within horizon.
414-433	loess I	3Bkb3	Olive (5Y4/3d); violently effervescent with common (18%), fine, irregular, soft masses of carbonate; consistence = 1.5 kg/cm^2.
433-442	loess I	3Ab2	Dark olive gray (5Y3/2d); charcoal band within horizon that contains a jaw bone; radiocarbon date of 3080±60 yr. BP from this lower midden.
442-491	loess I	3Bkb4	Olive (5Y4/3d); weak, coarse, subangular blocky structure; violently effervescent with disseminated carbonate.
491-495	loess I	3Abk	Dark olive gray (5Y3/2d); massive; violently effervescent with disseminated carbonate.
495-522	loess I	3Ck	Pale olive (5Y6/4d); massive; noneffervescent; subangular, medium grained, moderately sorted, quartz, sandy loam.
522-528	loess I	3Abk2	Black (5Y2.5/1); massive; violently effervescent with disseminated carbonate.
528-555 (TD)	loess I	3Ck	Olive (5Y4/4d); massive; violently effervescent with disseminated carbonate.